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OPERATIVE SURGERY

OPERATIVE SURGERY

OPERATIVE SURGERY

BY

HERBERT Wm. ALLINGHAM, F.R.C.S.

SURGEON TO THE HOUSEHOLD OF HIS MAJESTY THE KING;
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LATE ASSISTANT-SURGEON TO ST. MARK'S HOSPITAL FOR DISEASES OF THE RECTUM

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PREFACE

It is hoped that this work will be of service to surgeons wishing to hastily look up the leading features of an operation, and also to those who are performing operations upon the cadaver or watching them upon the living.

No attempt has been made to give lengthy descriptions or to mention all the operations in surgery, but simply to give a brief account, with special attention to the important points of those procedures which the author believes to be the best in the various regions. Similarly, the anatomy concerned in each operation is given with the greatest possible brevity, but should be sufficient in the hands of those for whom the work is intended to save the extra reference to an anatomical book. An attempt has been made in the memoranda to emphasize any specially important points concerned in the operations, or to give hints which it has been found from personal experience facilitate their performance.

I am greatly indebted to Mr. Lockhart Mummery, F.R.C.S., for the excellent illustrations, all of which he has done, also for his great assistance, with Dr. Blumfeld, in correcting the proofs.

HERBERT Wm. ALLINGHAM.

25, Grosvenor Street,
London, W.
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INTRODUCTORY CHAPTER

Methods of Using the Knife.

It is impossible to lay down any law as to the correct way in which to hold a knife, as the exact method of doing this varies with different surgeons. Undoubtedly the best method, and the one most commonly adopted, is that of holding the knife like a violin bow (Fig. 1, A). This position allows the operator to feel, more accurately than any other, the exact amount of force which is being used, and so to gauge the depth to which

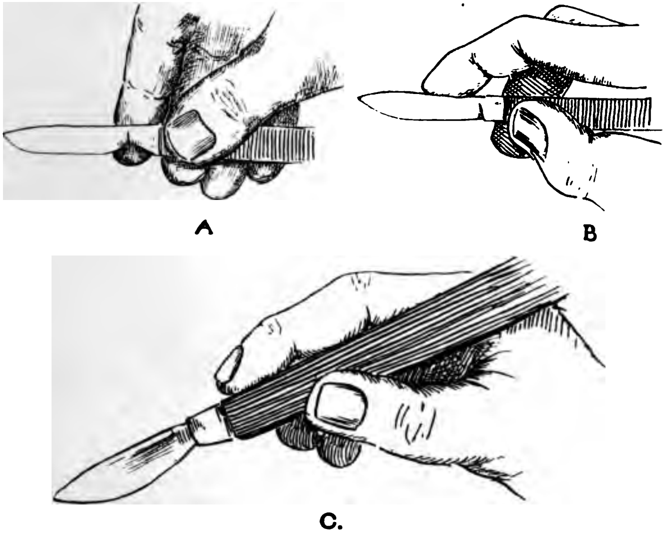

Fig. 1.—Methods of Holding the Knife.

he is cutting; also, when the knife is held in this position, the sharpest part of the blade, and that best suited for cutting, is brought into use; that is to say, the convex portion of the edge. This is by far the sharpest part of most scalpels. Another way of holding the knife, and one which is specially suitable where tough tissues have to be dealt with, is as a dinner-knife, with the forefinger on the back of the blade near its base (Fig. 1, B). The third method is to hold the knife like a penholder—between the forefinger and thumb (Fig. 1, C); this is the method most commonly adopted when fine dissections have to be carried out, as in the exposure of arteries, etc. As far as possible picking with the point of the blade should be avoided; the aim of the operator should be to make clean cuts from end to end of the wound. This is of importance, not only on account of neatness, but because clean incised wounds heal more readily and with less scarring than lacerated wounds. The deeper parts of the wound should always be made to extend to the limits of the skin incision; that is to say, the wound must not be allowed to tail off at the ends. A long clean wound is always preferable to a short one, the edges of which have been bruised by dragging on them with retractors.

Sutures.

There are several methods of closing the wound by suture, and each has its advocates. The *interrupted suture* (Fig. 2, A) is that most commonly used in sewing up incisions in the abdominal wall; each stitch is passed and tied off separately. A very good plan in closing incisions of this sort is to pass interrupted sutures of fishing-gut at intervals of about an inch through the whole thickness of the abdominal wall, including the peritoneum, and tie them in the ordinary way, then to bring the skin together between them with the same material, tied simply with a double hitch (Fig. 2, B), and cut the ends long. This has the advantage that the knot lies flat on the skin and is less irritating; also this suture can be loosened or tightened at any time by pulling on the ends. In the ordinary *continuous stitch* (Fig. 2, C) the needle is simply passed through from side to side, and the suture tied off at the end of the wound. The *blanket suture* (Fig. 2, D) is the same, except that the loop is caught up each time with the needle.

Where it has been found necessary to remove a large portion of the skin, and there is difficulty in getting the edges of the incision together, *tension sutures* are sometimes made use of:

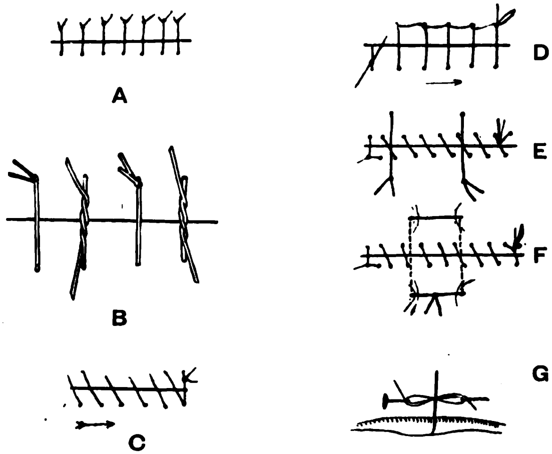

FIG. 2.—SUTURES.

these are sutures passed at a considerable distance from the edges of the wound so as to get a good grip of the skin.

The simplest form of tension suture is made by passing single sutures at some distance from the edge of the wound, as in Fig. 2, E. After the tension sutures have been put in, the edges of the wound must be brought together by a continuous suture.

Another form of tension suture is the mattress suture (Fig. 2, F). In this the thread is passed in on one side and out on the other; it is then passed in again on the same side at some little distance from the point at which it emerged, and out on the other side, at the same distance from the point at which it originally entered; the two ends are then tied together. This suture is often used in sewing up the peritoneum, where a simple stitch would cut out.

Another method of closing wounds is by means of hare-lip pins. It is a very useful method where a large portion of the lip has to be removed. The pins should be passed all but through the lip, and then out on the other side in the same way, so that the whole thickness of the lip is taken up except the mucous membrane. A figure-of-eight is then made over the ends of the pin with silk (Fig. 2, G), and the edges of the wound approximated.

The special kinds of sutures used in connection with intestinal surgery will be found mentioned in connection with that part.

Technique of Asepsis.

Cleaning the Hands.—It has been repeatedly proved that, however much care be taken, it is quite impossible to insure the hands being sterile, and therefore the surgeon should always be careful to keep his hands as free from sources of infection as possible; that is to say, he should avoid handling septic matter if it can be avoided. And when he has been obliged to do so, he should not perform an aseptic operation for some time afterwards. Keeping the hands free from infection, and not operating on aseptic cases shortly after septic ones, is of much more importance than elaborate disinfection.

A good method is to carefully wash the hands and forearms with soap and hot water, using a nail-brush for the nails, and then to rinse the soap off in clean water. The hands should then be dipped in an alcoholic solution of biniodide of mercury for a minute or two. (This solution is a 1 in 1,000 solution of biniodide of mercury in methylated spirit. It can be prepared by adding one of the biniodide soloids, as sold by Messrs. Burroughs and Wellcome, to 1 pint of methylated spirit; a little potassium iodide may be added to insure the biniodide dissolving, though this is not always necessary.) The value of the spirit is that it removes all grease, and insures the antiseptic reaching all parts of the skin. Lastly, the hands may be rinsed in a 1 in 2,000 solution of biniodide in water. Another way is to use turpentine to remove the grease, and then to rinse the hands in an antiseptic solution.

Sterilization of Instruments.—All instruments should be boiled in water, to which a little common washing soda has been added to prevent rusting, for at least fifteen minutes, and then transferred with sterile forceps to a tray containing 1 in 40 carbolic acid or sterile water. It must be remembered, however, that the spores of some organisms—notably anthrax and tetanus, and possibly tubercle—are not always destroyed by boiling for this space of time, and to insure the death of these spores the instruments would have to be boiled longer.

Disinfection of the Skin of the Patient.—The skin round the site of the proposed wound should, when possible, be cleaned twenty-four hours before the operation. The part having been shaved, the skin is washed thoroughly with soap and water; if very dirty, a nail-brush may be used with advantage. The skin is next washed with methylated ether or turpentine to remove the grease; it is then washed with some antiseptic lotion—preferably biniodide of mercury, 1 in 1,000, or the spirit solution already mentioned. A layer of wet gauze, wrung out of 1 in 2,000 or 1 in 3,000 biniodide solution, is then applied, and a sheet of jackanet or oil-silk placed over this. Mr. Lockwood advises wringing out the gauze in a solution containing glycerine, so that it may remain wet; the former method is, however, simpler. Lastly, a layer of wool is applied in the usual way. Before commencing the operation, the site of the wound should be again washed with the spirit lotion to remove any sweat or sebaceous material that may have been secreted since the dressing was applied.

Preparation of Ligatures—*Silk.*—The most convenient way of sterilizing silk is by boiling it in water for fifteen minutes. It should not be put into the water used for the instruments, as this contains soda, and if silk is boiled in soda it soon gets very rotten. The most certain way of sterilizing silk, especially in thick reels, is by placing it in an autoclave under a pressure of about 60 pounds to the square inch for ten or fifteen minutes. To preserve silk already sterilized, it should be wrapped round a glass slide or bobbin, and placed in a 1 in 500 solution of biniodide and spirit. Thin silk sterilizes more easily than thick.

Silkworm-Gut.—This can be readily sterilized by boiling, and it will stand repeated boilings without damage. It may be preserved in biniodide of mercury and spirit.

Preparation of Catgut.—As catgut is made from sheep's entrails, it is more liable to be infected with organisms than most other forms of ligature, and, unfortunately, it cannot be boiled, as it turns into jelly. The following method of sterilization, as recommended by Mr. Lockwood, will be found efficient if properly carried out: The catgut is carefully cleaned with a brush in soft soap and water, and then washed in clean water; it is then wound on glass slides or spools, and immersed in a solution of biniodide of mercury (1 in 1,000) for twelve hours, then in an alcoholic solution of biniodide of mercury (1 in 200) for twelve hours, and preserved dry in glass vessels, which should be air-tight, or in 1 in 500 carbolic solution.

Preparation of Towels.—These should be boiled for half an hour, or, better still, placed in an autoclave under pressure, as the inner folds of the towel may escape being sterilized by boiling.

Preparation of Sponges.—New sponges are first beaten and shaken to get rid of the sand, and then immersed in a solution of hydrochloric acid and water to dissolve any grit. The strength of the solution is 1 drachm of strong acid to 1 pint of water. They are then washed in sterilized water, and immersed for an hour in a warm solution of ordinary washing soda (1 drachm to the pint) to remove fat or albumin. The sponges are then rinsed again in sterilized water to remove the soda, and immersed in a cold solution of sulphurous acid (1 in 5) for twelve hours. Lastly, the sulphurous acid is washed away with sterile water, and they are placed in carbolic acid lotion (1 in 20) till wanted. When the sponges have been used before, the hydrochloric acid solution may be omitted.

Most of the above is taken from Mr. C. B. Lockwood's book on 'Aseptic Surgery,' to which the reader is referred for further information on this subject.

Knots and Ligatures.

The knot most commonly used in surgery is the reef knot (Fig. 3, A); it is used for tying arteries both when they have been clipped and in their continuity, and if it be properly tied there is very little tendency for it to slip; whereas the so-called 'granny knot' easily comes untied (Fig. 3, B). Many surgeons tie a third knot over the reef knot when tying vessels of importance, as many materials, especially catgut, are very liable to slip. In ligaturing arteries, as soon as the sheath of the vessel is exposed, it should be picked up with the dissecting forceps, and a small nick made into it with the knife; it should not be opened more than is absolutely necessary for conveniently passing the aneurism needle. When tying the ligature, the ends of the fingers should be passed down to the vessel, and the ligature tied on to it. The vessel must not be pulled away from its surroundings, as will be the case if the operator simply pulls on the ends of the ligature. The ligature should be pulled firmly and steadily; jerking should be avoided, if for no other reason than that it is very liable to break the ligature.

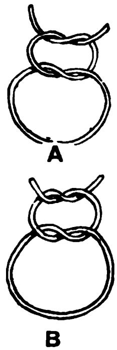

FIG. 3.

For securing pedicles when removing large tumours or organs, as the kidney, etc., there are two knots in common use which must be briefly described:

1. **The Transfixion Ligature.**—A looped ligature is passed through the centre of the pedicle with an aneurism

needle (Fig. 4, A); the loop is then pulled out and divided, thus leaving a double ligature through the pedicle; each half is then tied off separately (Fig. 4, B), and finally a turn is taken round the whole pedicle and tied.

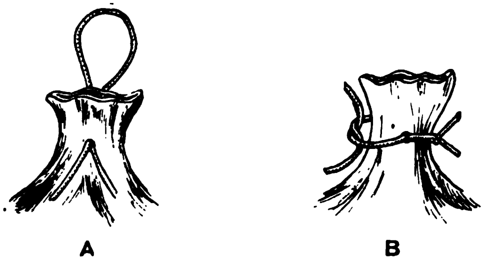

FIG. 4.

2. **The Staffordshire Knot.**—This is made by passing the double ligature through the pedicle as before (Fig. 5, A); the loop, instead of being divided, is then passed over the tumour, and one of the ends of the ligature is passed above the loop, and the other below (Fig. 5, B). The ends of the ligature are then pulled tight and tied (Fig. 5, C); the ends may then, if it is thought desirable, be brought round again to the other side and tied.

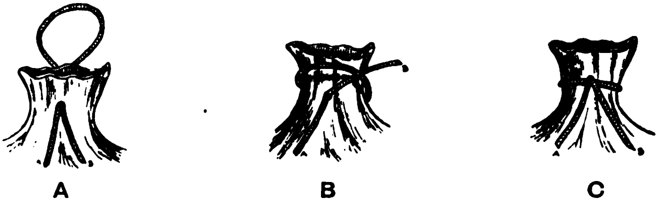

FIG. 5.

Instruments.

The great thing to be aimed at in the selection of instruments is simplicity, both as regards number and design. The fewer and simpler they are, the better. The following list of instruments contains all that are *absolutely* necessary for the vast majority of operations, though, of course, many surgeons commonly make use of a few other special instruments which they have found from experience to be convenient for the particular case; but the beginner should confine himself to as few instruments as are necessary.

One dozen clips.
One pair dissecting forceps.
Scalpel.
One pair scissors.
Probe-pointed director.
Aneurism needle.
Needles (straight or curved).

The following additional instruments, though not always necessary, will be found convenient: Retractors, a Volkmann's spoon, and a bivalved tracheotomy-tube.

The following is a list of more or less common operations for which special instruments are necessary:

1. HERNIA CASES.—Hernia knife and director, and a needle set in a handle for passing deep sutures.
2. BONE CASES. — Saw, chisels, periosteal elevator, and gouges. A pair of Hoffmann's necrosis forceps are also very convenient.
3. AMPUTATIONS.—Saw, special amputating knife, and tourniquet.
4. EXCISION OF JOINTS.—Saw, lion forceps, periosteal elevator, bone-cutting forceps, metal spatula, gouge. An Adam's saw is necessary for the hip.
5. BLADDER CASES. — Sound, lithotrite and evacuator, grooved staff, lithotomy scoop, and syringe to distend bladder.
6. FOR OPERATIONS ON THE HEAD.—Trephines of various sizes, a pair of Hoffmann's necrosis forceps for enlarging the openings, a pair of very fine sinus forceps for exploring the brain tissue if necessary, and exploring syringe.

7. REMOVAL OF INTRA-ABDOMINAL ORGANS.—Two pairs of large pedicle clamps, irrigator, broad retractors, and an exploring syringe.
8. OPERATIONS ON THE CHEST.—Bone forceps, periosteal elevator, director, and exploring syringe.

For the operations on the eye, nose, throat, uterus, etc., the number of instruments is so great, and different surgeons vary so much in those which they use, that it would be futile to mention them here. It is well to remember that skill in using some simple instrument is better worth acquiring than the knowledge of how to use some complicated and special instrument.

PART I

CHAPTER I

ARTERIES OF THE UPPER EXTREMITY

RADIAL ARTERY.

THE artery's course is represented by a line drawn from the outer border of the tendon of the biceps to just ½ inch inside the styloid process of the radius.

Ligature of the Lower Third of the Radial Artery.

ANATOMY (Fig. 6).

In Front.

Skin and superficial fascia.
Deep fascia.

Outer Side.		*Inner Side.*
Tendon of supinator longus.	[Artery.]	Tendon of flexor carpi radialis.

Behind.

Pronator Quadratus.

In the living the pulsation of the artery can be felt.

The tendon of the flexor carpi radialis can always be easily felt and seen on the inner side of the front of the wrist.

Operation (Fig. 7).

The arm is supine and the wrist extended. The operator, standing on the right of the limb, makes a vertical incision 2 inches long over the course of the artery, the knife being used very lightly so as to divide only the skin and superficial fascia. The deep fascia is exposed and opened. The vessel is then to be found surrounded by its venæ comites. With director and forceps the artery is separated, the aneurism needle passed, and the vessel secured.

Memoranda.

I. Keep between the flexor carpi radialis tendon and that of the supinator longus.

II. Cut very lightly; otherwise by the first incision the deep fascia may be opened and the radial artery wounded, or the operator, not knowing that the deep fascia has been divided, may be hunting about on the fascia covering the pronator quadratus, having already passed the artery.

III. Do not open the synovial sheaths of the tendons exposed.

IV. The radial nerve is in no relation with the artery in this part of the arm.

Ligature of the Middle Third of the Radial Artery.

ANATOMY (Fig. 6).

In Front.
Skin, superficial and deep fascia.
Supinator longus.

Outer Side.
Supinator longus.
Radial nerve (little away from it).

[Artery.]

Inner Side.
Flexor carpi radialis.

Behind.
Pronator radii teres.

Operation (Fig. 7).

The arm being supinated, an incision 2 inches long is made in the course of the artery. The superficial and deep fascia are divided, and the supinator longus muscle as it is becoming tendinous is exposed. Superficial veins or nerves are avoided. The inner or ulnar border of the supinator longus is seen and is drawn outwards. The artery is then exposed by dividing a little fascia that binds it to the deeper muscles; the aneurism

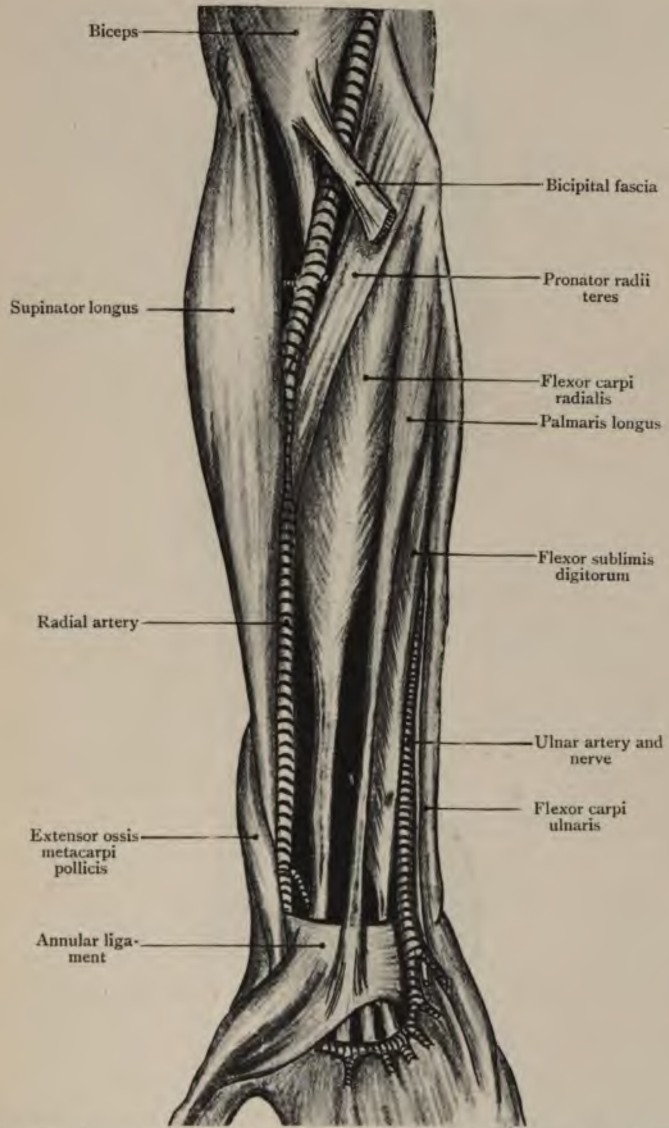

FIG. 6.—ANATOMY OF THE RADIAL AND ULNAR ARTERIES: ANTERIOR ASPECT OF RIGHT FOREARM.

needle is then passed from without inwards so as to avoid the radial nerve.

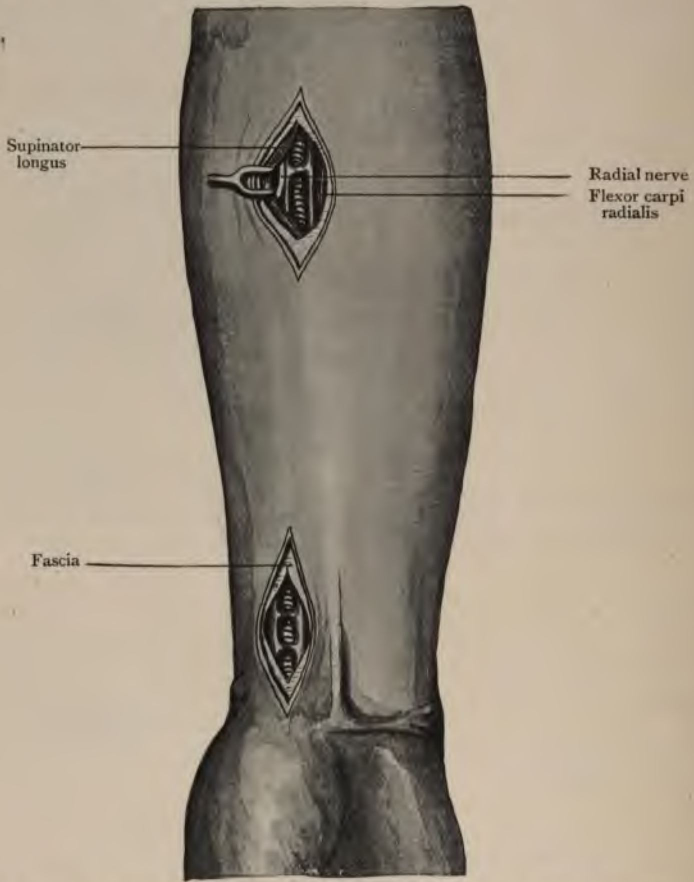

FIG. 7.—LIGATURE OF THE RADIAL ARTERY IN LOWER AND MIDDLE THIRDS.

Memoranda.

I. In searching for the vessel, make sure to be on the ulnar side of the supinator longus tendon.

II. If the artery is sought towards the upper part of its middle third, it is likely to be a little under the supinator longus muscle, and the radial nerve may then be near to it. Avoid taking up the nerve in the ligature.

Ligature of the Upper Third of the Radial Artery.

ANATOMY (Fig. 6).

In Front.
Superficial and deep fascia.
Supinator longus.

Outer Side.		*Inner Side.*
Supinator longus (vertical fibres).	**[Artery.]**	Pronator radii teres (oblique fibres).

Behind.
Supinator brevis.

Operation (Fig. 7).

Make an incision 2½ inches long in the course of the vessel, about 1½ inches below the bend of the elbow. The superficial and deep fascia are divided. The white line indicating the interval between the supinator longus and pronator radii teres is then exposed and opened up. The muscles are retracted and the artery exposed and secured. The aneurism needle can be passed either way, the radial nerve being here in no near relation to the artery.

Memoranda.

I. Open up the interval between the supinator longus and pronator radii teres. This may be insured by remembering the direction of the fibres, the supinator being vertical, the pronator oblique.

II. In very muscular arms the interval between the supinator longus and pronator muscle may be nearer than usual to the inner aspect of the arm. If in doubt as to the position of the interval, look for a white line. If two white lines are exposed, open up the innermost.

ULNAR ARTERY.

The course of the artery is represented by a line drawn from the middle of the bend of the elbow to the outer side of the pisiform bone.

Ligature of the Lower Third of the Ulnar Artery.

ANATOMY (Fig. 6).

In Front.
Skin, superficial and deep fascia.
A few superficial veins and nerves.

Outer Side.		*Inner Side.*
Flexor sublimis digitorum.	[Artery.]	Flexor carpi ulnaris and ulnar nerve.

Behind.
Flexor profundus digitorum.

The tendon of the flexor carpi ulnaris is easily seen and felt.

Operation (Fig. 8).

The arm being supinated, an incision about 1½ inches long in the line of the artery is made, the superficial fascia divided, and any superficial veins or nerves turned aside; the deep fascia is then opened up. The tendon of the flexor carpi ulnaris is seen and pulled inwards. A thin piece of fascia may then be perceived binding down the artery and nerves; this is divided, and the artery and nerve exposed. The aneurism needle is passed from within outwards.

Memoranda.

I. The nerve is to the inner side of the artery.

II. Keep between the flexor carpi ulnaris and the innermost tendon of the flexor sublimis digitorum. Do not become lost amongst the tendons of the latter muscle.

III. The outer side of the flexor carpi ulnaris is tendinous to its insertion, whereas the inner side has muscular fibres attached to the tendon almost down to the pisiform bone.

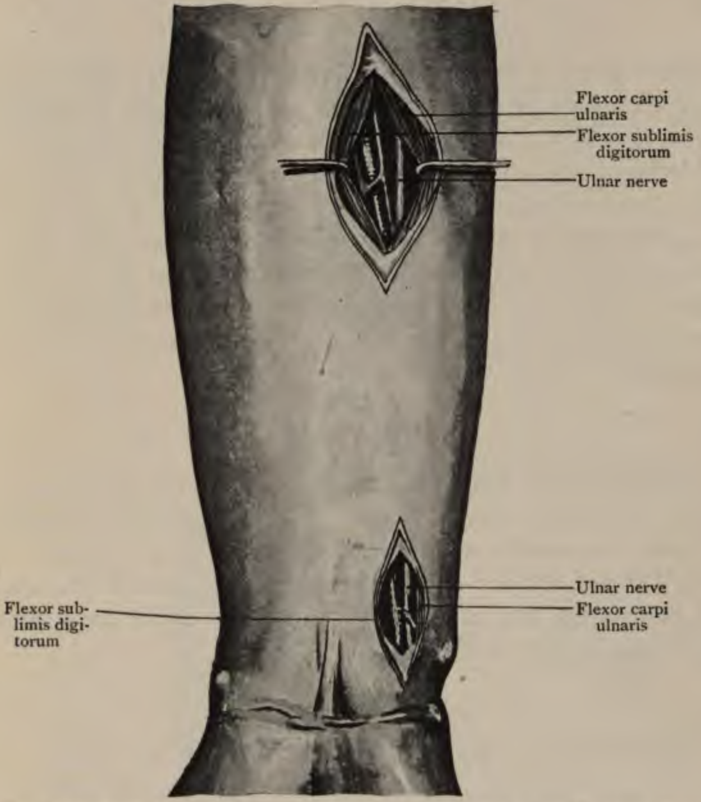

FIG. 8.—LIGATURE OF THE ULNAR ARTERY IN THE LOWER AND MIDDLE THIRDS.

Ligature of the Middle Third of the Ulnar Artery.

ANATOMY (Fig. 6).

In Front.
Skin, superficial and deep fascia.
Flexor sublimis digitorum.

Outer Side.
Flexor sublimis digitorum.

[Artery.]

Inner Side.
Flexor carpi ulnaris and ulnar nerve.

Behind.
Flexor profundus digitorum.

2

Operation (Fig. 8).

The arm being supinated, an incision 3 inches long is commenced about four fingers' breadth below the bend of the elbow in the line of the artery. The skin and superficial fascia are divided and the superficial veins and nerves drawn aside. The white line between the flexor carpi ulnaris and flexor sublimis digitorum is looked for. This is then opened and the muscles separated. The artery will be seen surrounded by its accompanying veins, the ulnar nerve being a little to its inner side. The artery is freed and the aneurism needle passed from within outwards.

Memoranda.

I. The interval between the flexor sublimis digitorum and flexor carpi ulnaris may be seen or felt, or a small vessel coming between the muscles will indicate the line between them.

II. Do not cut too deeply, thus passing beyond the artery, and so opening the interspace between the flexor carpi ulnaris and flexor profundus digitorum.

Collateral Circulation.

Anterior and posterior interosseous + anterior carpal.
,, ,, ,, + posterior carpal.
,, ,, ,, + recurrent branch of deep palmar arch.

BRACHIAL ARTERY.

The course of the artery is represented by a line drawn from the junction of the inner with the middle third of the axilla to the middle of the anterior aspect of the elbow-joint. This is, with the forearm, extended and abducted, and the arm supinated.

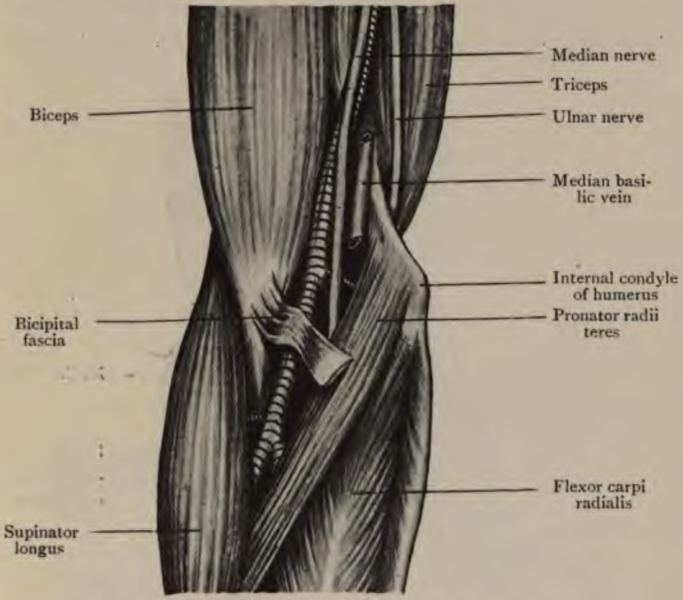

FIG. 9.—ANATOMY OF THE BRACHIAL ARTERY.

Ligature of the Brachial Artery at the Elbow-Joint.

ANATOMY (Fig. 9).

In Front.
Skin, fascia.
Bicipital fascia.
Median basilic vein.

Outer Side.
Biceps tendon.

[Artery.]

Inner Side.
Median nerve.

Behind.
Brachialis anticus.

Operation (Fig. 10).

With the elbow slightly flexed, an incision about 2 inches long is made just inside the biceps tendon. The incision should be lightly made, and any superficial nerves and veins avoided and pulled aside. The deep fascia is then divided, and next the bicipital fascia; the artery and the veins are found immediately under it. The artery is separated from the veins, and the aneurism needle passed from within outwards.

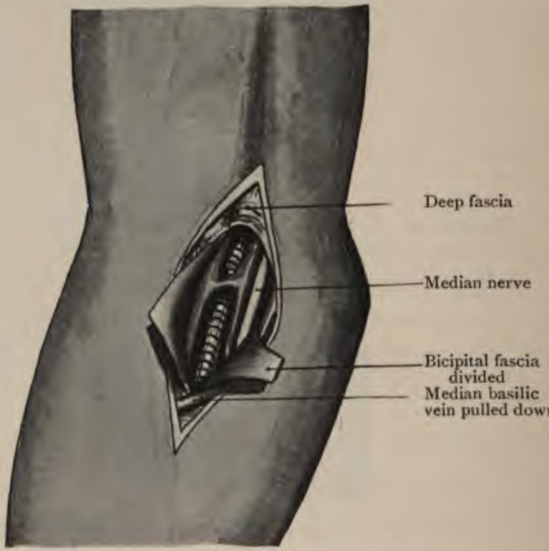

FIG. 10.—LIGATURE OF THE BRACHIAL ARTERY AT THE BEND OF THE ELBOW.

Memoranda.

I. If possible, avoid wounding the median basilic vein.

II. Do not divide more of the bicipital fascia than is necessary.

Ligature of the Middle Third of the Brachial Artery.

ANATOMY (Fig. 9).

In Front.
Skin and fascia.
Median nerve.

Outer Side.
Biceps.

[Artery.]

Inner Side.
Ulnar nerve.
Internal cutaneous nerve.

Behind.
Triceps.
Insertion of coraco-brachialis.
Perhaps the musculo-spiral nerves and superior profunda artery.

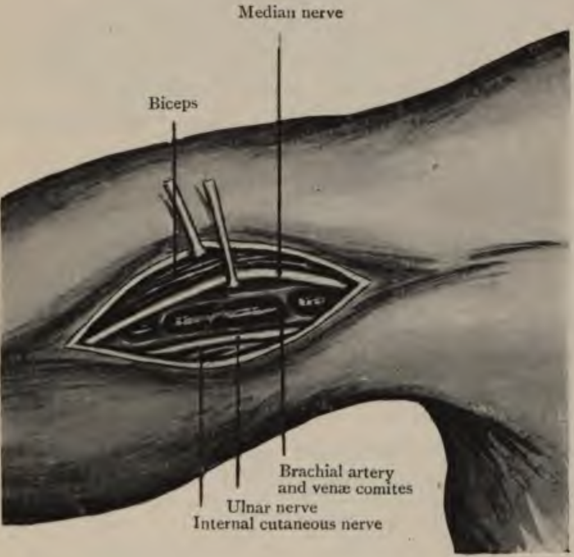

FIG. 11.

Operation (Fig. 11).

The arm is abducted and extended. The surgeon stands on the outer or inner side of the limb (whichever preferred), and makes an incision about 3 inches in length in the line of the artery about the middle third of the arm. The superficial fascia is divided and the deep fascia exposed; this fascia is opened, bringing into view the biceps muscle. The biceps is then drawn outwards. The median nerve is found crossing the artery, and is drawn aside. The artery is exposed, cleared, and ligatured, all the veins and nerves being carefully avoided when passing the aneurism needle.

Memoranda.

I. The arm must not rest on anything while exposing and securing the artery, as the triceps may be pushed up and so be in the way.

II. The median nerve sometimes passes behind the artery.

III. At times the ulnar and radial arteries are given off high up in the arm, and then together represent the brachial.

IV. The superior profunda comes off about the region of ligature, and must not be mistaken for the brachial artery.

Collateral Circulation.

If the artery is ligatured *below* the superior profunda:

Superior profunda + radial recurrent.
,, ,, + post-ulnar recurrent.
,, ,, + interosseous recurrent.
,, ,, + anastomatica magna.

If the artery is ligatured *above* the superior profunda:

Subscapular + superior profunda.
Anterior circumflex + ,, ,,
Posterior circumflex + ,, ,,

AXILLARY ARTERY.

This artery can be ligatured in the first or third parts.

With the arm abducted, the line of the vessel is from the centre of the clavicle to the insertion of the coraco-brachialis at the middle of the arm.

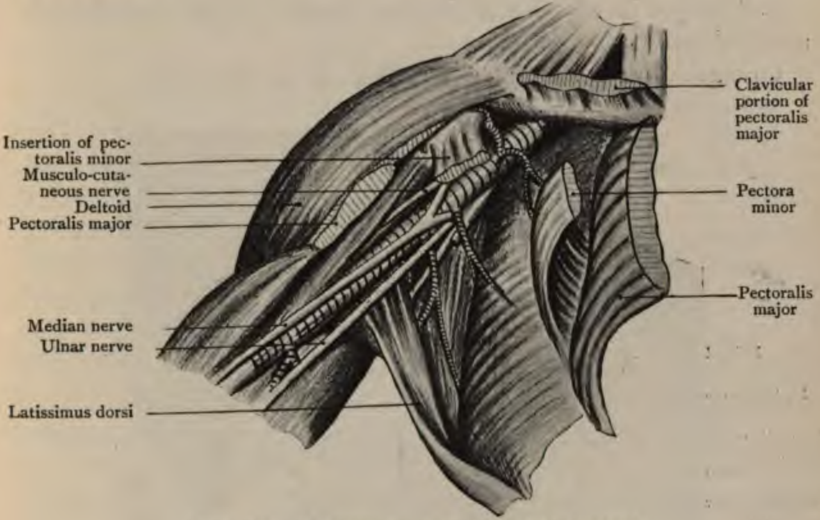

FIG. 12.—ANATOMY OF THE AXILLARY ARTERY.

Ligature of the First Part of the Axillary Artery.

ANATOMY (Fig. 12).

In Front.

Skin, fascia and platysma.
Pectoralis major.
Costo-coracoid membrane.
Cephalic vein
(often overlapped by axillary vein).

Outer Side.		*Inner Side.*
Brachial plexus.	[Artery.]	Axillary vein.

Behind.

First serration of serratus magnus.
First intercostal space.
Long thoracic nerve.

Methods of Incision for Ligature of the Axillary Artery in the First Part.

1. A transverse convex cut, just below the clavicle.
2. An incision made over the interval between the pectoralis major and the deltoid.
3. Oblique incision—that is, one running in the line of the artery downwards and outwards.

Operation by the first incision will alone be described.

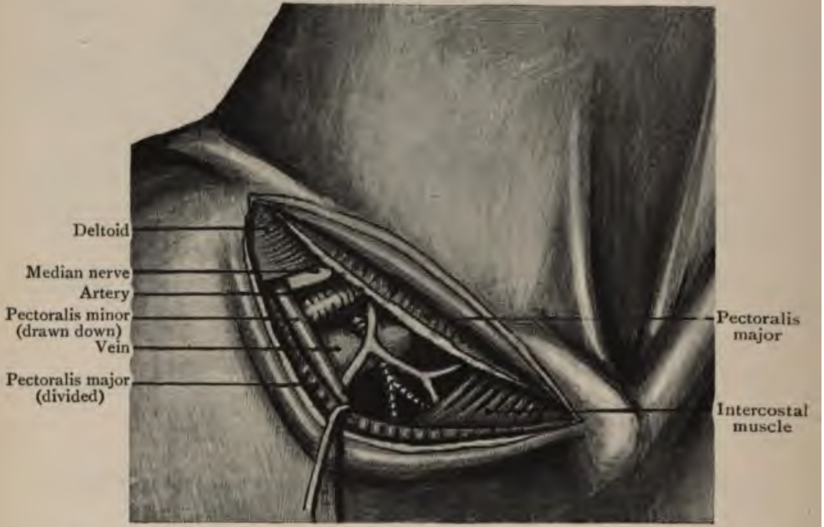

FIG. 13.—LIGATURE OF THE FIRST PART OF THE AXILLARY ARTERY.

Operation (Fig. 13).

The patient lies on the back, the shoulder is slightly raised and the arm abducted; the operator sits on the side of the operation between the limb and the body. A slightly convex incision, with the convexity downwards, is then made about ½ inch below the clavicle, commencing near the sterno-clavicular joint, and ending inside the coracoid process. The pectoralis major is exposed and its thickness divided. The cellular tissue is then opened up, and the upper edge of the pectoralis minor is seen, and that muscle pulled downwards. The costo-coracoid membrane is next exposed, and is divided with great care. In the wound, towards the coracoid process, the vessels will be felt. The sheath is carefully opened, and the aneurism needle passed from below.

Memoranda.

I. The incision must not be made too low beneath the clavicle, or else, after the pectoralis major has been divided, the upper border of the pectoralis minor may be difficult to find.

II. The cephalic vein is in the outer part of the wound, running up between the deltoid and pectoralis major. This should not be wounded.

III. The axillary vein is on the inner side of the artery, and frequently greatly overlaps that vessel, covering it on its anterior aspect, so care must be taken not to wound it on exposing the artery.

Ligature of the Third or Lowest Part of the Axillary Artery.

When the arm is abducted, the line of artery runs from the centre of the clavicle along the inner border of the coraco-brachialis to its insertion.

ANATOMY (Fig. 12).

In Front.
Skin and fascia.

Outer Side.
Coraco-brachialis.
Median and musculo-cutaneous nerves.

[Artery.]

Inner Side.
Internal cutaneous nerve.
Ulnar nerve.
Axillary vein.

Behind.
Subscapularis.
Latissimus dorsi.
Circumflex nerve.
Musculo-spiral nerve.

Operation.

With the arm abducted and slightly rotated outwards, an incision about 3 inches long is made in the line of the artery, commencing on a level with the anterior fold of the axilla, and continued along the inner margin of the coraco-brachialis muscle. The deep fascia is opened and the coraco-brachialis muscle exposed; along its inner edge will be found the axillary vessels and nerves. The vein is then drawn inwards, the median nerve outwards, the artery freed from its sheath, and the aneurism needle passed from within outwards.

Memoranda.

I. Expose the coraco-brachialis muscle on its inner side, as a guide for finding the artery.

II. The vessel is surrounded by nerves, so great care must be taken to isolate it, and not to ligature a nerve in mistake for the artery.

III. Do not apply the ligature very near to any large vessel that may be coming off from the artery.

Collateral Circulation.

When tied in first part above thoracic axis:

Suprascapular + infrascapular.
Posterior scapular + infrascapular.
Internal mammary + $\begin{cases}\text{short and long thoracic and} \\ \text{infrascapular.}\end{cases}$

When ligatured in the third part:

Subscapular + superior profunda.
Anterior circumflex + ,, ,,
Posterior circumflex + ,, ,,

CHAPTER II

NERVES OF THE UPPER EXTREMITY

ULNAR NERVE.

The Ulnar Nerve at the Wrist.

Anatomy (Fig. 6).

THE flexor carpi ulnaris is the guide to the nerve, the nerve being just to the outer side of this tendon.

Operation.

An incision about 1½ inches long is made just above the wrist-joint, parallel to and to the outer side of the flexor carpi ulnaris tendon. The skin and fascia are divided, and the nerve and artery exposed, the artery being to the outer side.

The Ulnar Nerve at the Bend of the Elbow.

Anatomy.

About 2 inches above the internal condyle it pierces the internal intermuscular septum to pass to the back of the elbow, being then placed in the groove between the internal condyle and the olecranon.

Operation.

An incision about 2 inches long is made on the inner part of the arm a little more towards the back than the front. This incision extends to about ½ inch above and behind the internal condyle; the intermuscular septum is exposed, and just behind is found the ulnar nerve, the inferior profunda artery lying close to it.

Memorandum.

Take care to keep to the back of the intermuscular septum.

The Ulnar Nerve in the Middle of the Arm.

Anatomy.

The nerve follows the line of the brachial artery, being about ½ inch to its inner side.

Operation.

The incision should be about 2 inches long, as for tying the brachial artery in middle third of arm, but it is made ½ inch more towards the back of the arm. The skin, superficial and deep fascia are divided and the nerve exposed.

Memoranda.

I. The brachial artery must not be exposed, as there then may be some confusion between the ulnar and median nerves. Keep well to the inner side of line of the brachial artery.

II. Remember the nerve of Wrisberg is near to the ulnar nerve, and must not be confused with it.

MEDIAN NERVE.

The Median Nerve at the Wrist.

Anatomy (Fig. 14).

The tendon of the flexor carpi radialis is the guide to the nerve, the nerve being just to the ulnar side between it and the sublimis tendon, and covered by the tendon of the palmaris longus.

Operation.

An incision from 1 to 2 inches long is made just above the wrist to the inner side of the tendon of the flexor carpi radialis. The nerve is easily exposed.

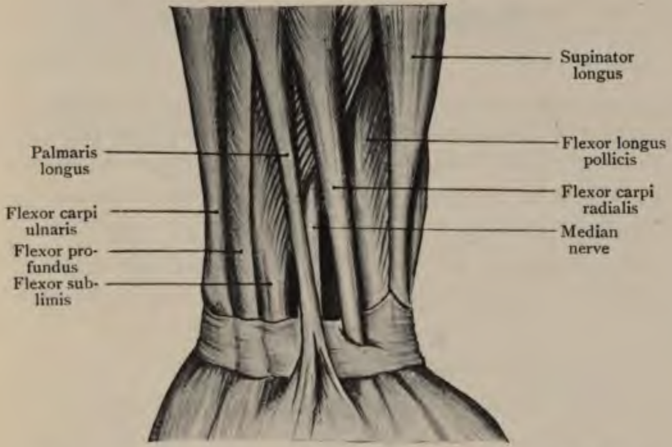

FIG. 14.—RELATIONS OF THE MEDIAN NERVE AT THE WRIST.

The Median Nerve at the Bend of the Elbow.

Anatomy (Fig. 10).

The guide to the nerve is the tendon of the biceps; the nerve is to its inner side.

Operation.

An incision about 2 inches long is made ½ inch to the inner side of the tendon of the biceps. The nerve is easily exposed. It lies to the inner side of the brachial artery.

The Median Nerve in the Arm.

Anatomy.

Same as that of the brachial artery in this region.

Operation.

As for ligature of the brachial artery. The nerve crosses the artery about the middle of the arm.

Memorandum.

The nerve sometimes passes behind the artery.

MUSCULO-SPIRAL NERVE.

Anatomy (Fig. 15).

The nerve runs through the axilla, and at about the level of tl insertion of the latissimus dorsi passes to the back of the humeru

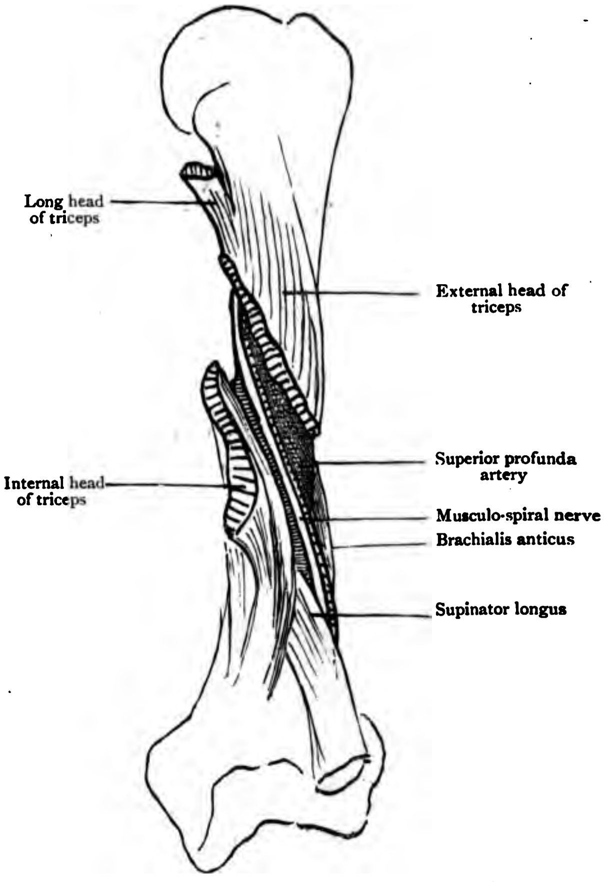

FIG. 15.—RELATIONS OF THE MUSCULO-SPIRAL NERVE ON THE BACK OF THE HUMERUS.

resting in a groove between the internal and external heads of t triceps. It then passes downwards and outwards to the outer aspe of the bone, where it pierces the external intermuscular septu about 3 inches above the external condyle; after this it comes to the front and outer part of the arm, where it lies between supinator longus and brachialis anticus, in which place it is to be sought for.

Operation.

An incision is commenced 3 inches above and in front of the external condyle, and carried downwards in the line of the supinator longus muscle. The edge of that muscle is seen. The fascia having been divided, the muscle is pulled outwards, and between it and the brachialis anticus the nerve will be found.

Memoranda.

I. Keep to the inner side of the supinator longus muscle.

II. The nerve is deeply seated between the supinator longus and the brachialis anticus.

III. The superior profunda artery runs with the nerve. Do not injure the artery.

CHAPTER III

EXCISION OF THE JOINTS OF THE UPPER EXTREMITY

THE PHALANGEAL AND METACARPO-PHALANGEAL JOINTS OF THE FINGERS AND THUMB.

Operations.

1. Lateral incision.
2. Latero-dorsal incision.

1. **Lateral Incision.**—An incision ½ inch long is made on both sides of the joint which it is desired to resect, the incisions being made rather towards the posterior part of the joint so as to avoid the digital arteries and nerves. The joint is exposed; the soft parts in front and at the back of the joint are cleared from the bones; the lateral ligaments are divided, and the ends of the bones turned out and cut off. This is the best method for the phalangeal joints.

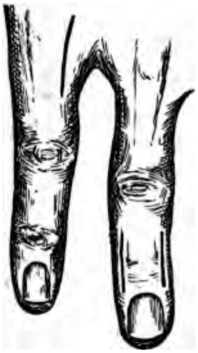

FIG. 16.—FIRST AND SECOND FINGERS TO SHOW THE INCISIONS FOR EXCISION OF THE PHALANGEAL AND METACARPO-PHALANGEAL JOINTS.

2. **Latero-Dorsal Incision.**—An incision 1½ inches long is made at the back of the joint, rather to one side, to avoid the dorsal tendon. The structures surrounding the joint are cleared from the bones, the joint opened, the ends of the bones brought out of the wound, and removed. This is best for the metacarpo-phalangeal joints.

Memoranda.

I. Do not wound or divide the tendon.
II. Avoid wounding digital arteries and nerves.

THE WRIST-JOINT.

Anatomy (Fig. 17).

The styloid processes can be felt and seen, and a slightly curved line concave downwards drawn across the back of the wrist from the tip of one styloid process to the other marks the radio-carpal joint.

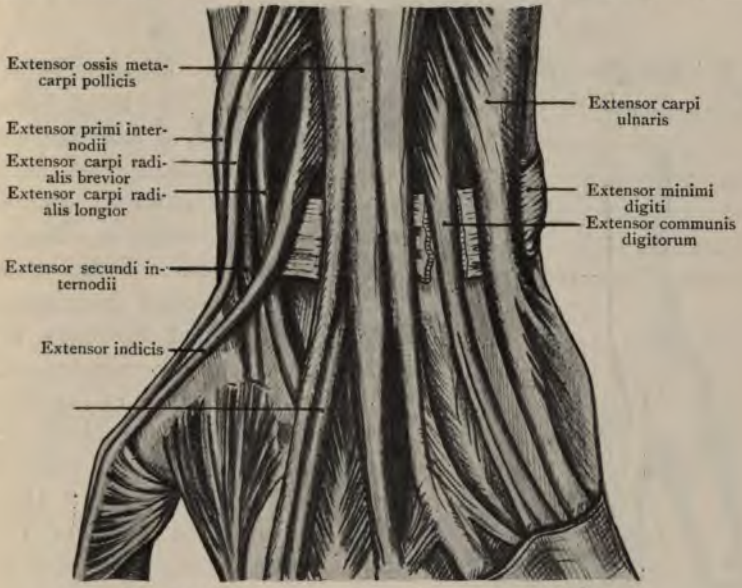
Extensor ossis metacarpi pollicis
Extensor primi internodii
Extensor carpi radialis brevior
Extensor carpi radialis longior
Extensor secundi internodii
Extensor indicis
Extensor carpi ulnaris
Extensor minimi digiti
Extensor communis digitorum

FIG. 17.—ANATOMY OF THE BACK OF THE WRIST.

In order that the tendons about the back part of the wrist may be remembered, it is important to enumerate them. Starting from without inwards can be observed the stout tendon of the extensor ossis metacarpi pollicis, and lying in contact with it, and visible in some subjects, is the extensor primi internodii pollicis. Then there is an interval—viz., the anatomical snuff-box—in the floor of which lies the radial artery; next to this, and at the back of the radius, can be felt a small prominence of bone. To the inner side of this—in fact, passing off at an oblique angle to it—is the tendon of the extensor secundi internodii pollicis. In proximity we find the extensors carpi radialis longior and brevior, and about the centre of the wrist are to be seen the tendons of the extensor communis digitorum and extensor indicis. More to the outer side, in the interval between the radius and ulna, is the extensor minimi digiti; in strong hands this is occasionally visible. Lastly, just behind the styloid process of the ulna the tendon of the extensor carpi ulnaris can be felt.

Excision of the Wrist.

Operations.

1. Single dorsal incision (von Langenbeck).
2. Two dorsal incisions (Ollier).
3. Lord Lister's operation.

1. Single Dorsal Incision (von Langenbeck) (Fig. 18).—This is the best and simplest. The hand being slightly abducted, a long vertical incision is made along the radial border of the extensor indicis tendon. This incision begins close to the middle of the ulnar margin of the second metacarpal bone, is prolonged upwards for about 5 inches, and terminates over the radius at the angle of junction of the extensor indicis and the extensor secundi internodii pollicis. The extensor tendons are then detached from the back of the radius, those to the inner side of the incision being pulled inwards, and those to the outer side pulled outwards. The capsule of the wrist-joint is then opened, and the hand flexed; the carpal bones projected out of the wound are removed with bone forceps, any adhesions being separated with the knife. Lastly, the ends of the metacarpal bones and the radius and ulna may be pushed into the wound and removed if diseased.

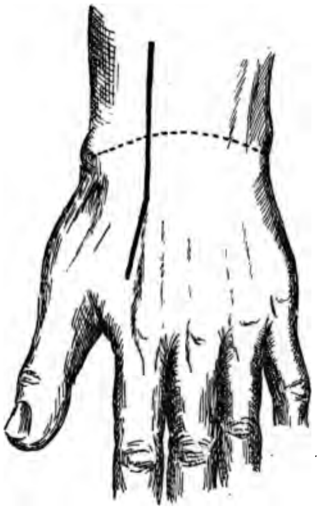

FIG. 18.—EXCISION OF THE WRIST-JOINT: SINGLE DORSAL INCISION (VON LANGENBECK).

Memoranda.

I. Be careful not to disturb, move or divide more tendons than absolutely necessary.

II. The pisiform bone may be left, and the unciform process of the unciform bone. The same applies to the trapezium, as these bones are rarely diseased and have important structures attached to them.

III. Avoid wounding the radial artery, which lies close to the trapezium.

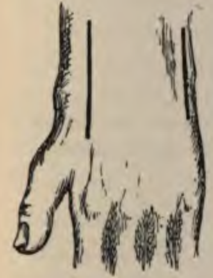

FIG. 19. — EXCISION OF THE WRIST-JOINT: TWO DORSAL INCISIONS.

2. Two Dorsal Incisions (Fig. 19). — The *radial incision* commences opposite the centre of the shaft of the second metacarpal bone, and is continued upwards along the outer side of the extensor indicis tendon. This part of the incision is oblique to, and on a level with, the centre of the back of the wrist. It is then carried straight upwards, the whole length of the incision being about 5 inches.

The ulnar incision commences about 1 inch above the styloid process of the ulna — to the inner side of the extensor carpi ulnaris tendon—and extends downwards to about ½ inch above the base of the metacarpal bone of the little finger.

The rest of this operation is completed as above described.

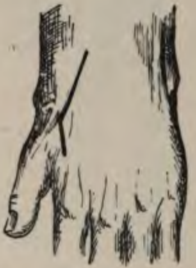

FIG. 20. — EXCISION OF THE WRIST-JOINT: LISTER'S METHOD.

3. Lister's Method (Fig. 20). — *The radial incision* commences about the middle of the dorsal aspect of the radius on a level with the styloid process; thence it is carried towards the inner side of the metacarpo-phalangeal joint of the thumb, running parallel to the extensor secundi internodii pollicis tendon. As soon as it reaches the radial border of the second metacarpal bone, it is carried directly downwards for half the length of that bone.

The ulnar incision commences about 2 inches above the styloid process of the ulna, and is carried down to about the middle of the fifth metacarpal bone. This incision is towards the palmar aspect of the wrist, between the bone and the *flexor* carpi ulnaris.

THE ELBOW-JOINT.

Anatomy (Fig. 21).

The prominence of the internal and external condyles can be seen and felt. Just below the external condyle, with the arm extended, is a dimple; with the thumb placed on this, if the arm be pronated and supinated, the head of the radius can be felt. The anconeus passes from the external condyle to be inserted into the upper part of the outer surface of the ulna. Just to the outer side of the internal condyle, and between it and the olecranon, is a deep groove, in which is situated the ulnar nerve.

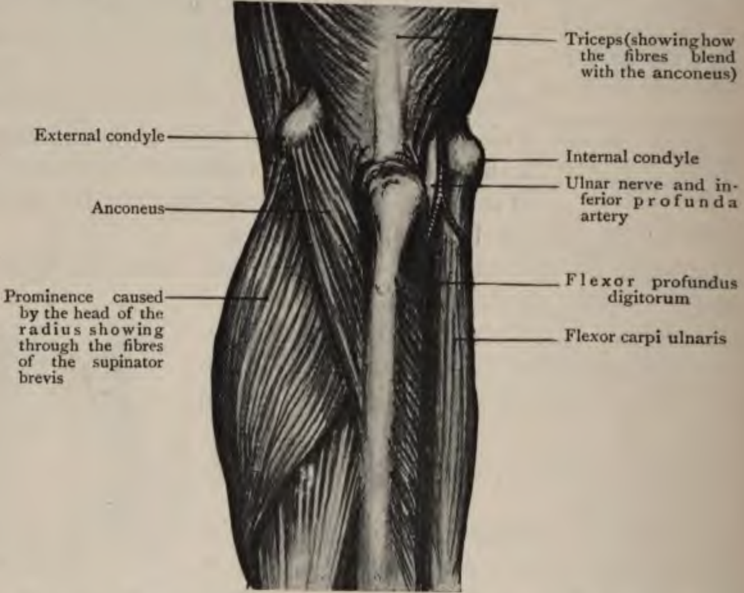
Triceps (showing how the fibres blend with the anconeus)
External condyle
Internal condyle
Ulnar nerve and inferior profunda artery
Anconeus
Flexor profundus digitorum
Prominence caused by the head of the radius showing through the fibres of the supinator brevis
Flexor carpi ulnaris

FIG. 21.—EXCISION OF THE ELBOW: ANATOMY OF THE BACK OF THE LEFT ELBOW.

Excision of the Elbow.

Operations.

1. Central longitudinal dorsal incision (von Langenbeck).
2. Long radial incision (Huet).
3. Longitudinal and transverse incision (Nélaton).
4. **H**-shaped incision (Syme).

1. Central Longitudinal Dorsal Incision (Fig. 22).—The patient lies on the back. The shoulder is raised, the arm flexed and carried over the body; the surgeon stands on the opposite side of the patient. A longitudinal incision is made at least 5 inches long, its centre over the tip of the olecranon. This incision commences above, and is carried to the bone, splitting the triceps muscle. The elbow-joint is then opened by cutting into it above the olecranon. The thumb of the left hand should be inserted into the cut, and the tissues towards the inner side of the joint well pulled outwards, while the knife is kept close to the bone; the ulnar nerve is then separated by an elevator from its groove behind the internal condyle. The soft parts with the ulnar nerve are turned over the internal condyle, and attention is paid to the outer side of the incision. The soft parts are forcibly retracted with the thumb, and the knife is kept quite close to the bone while dissecting them off. After this the anconeus and triceps are separated from the bone

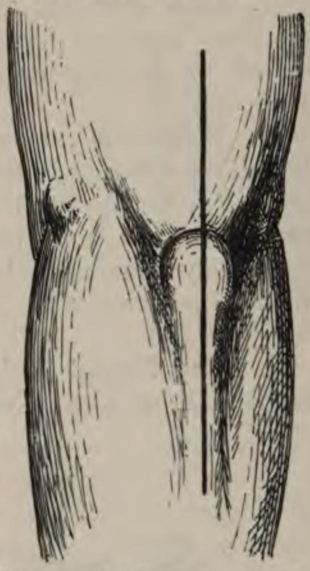

FIG. 22.—EXCISION OF THE ELBOW: CENTRAL LONGITUDINAL DORSAL INCISION.

which is to be removed. The lateral ligaments are divided, the joint strongly flexed, and the ends of the bones turned out of the wound. The olecranon is then sawn off on a level with the coronoid process so as to remove the great and lesser sigmoid cavities. The head of the radius is cut away. Lastly, the lower end of the humerus is removed, the section being made just above all the articular surfaces.

Memoranda.

I. Take care not to wound the ulnar nerve just behind the internal condyle.

II. While operating, every now and then take note which is the inner aspect of the joint. As the back of the arm is presented to the operator, it confuses the relation of parts somewhat.

III. Remember to remove a sufficient amount of the bones—*i.e.*, all the articular surfaces.

IV. Try to separate the triceps and anconeus on the outer part of the joint in one piece.

V. Only remove the head of the radius. Do not interfere with the insertion of the biceps tendon.

2. Long Radial Incision (Fig. 23).—An ***ulnar incision*** is made about an inch in length, rather to the anterior and inner side of the internal condyle, just in front of the ulnar nerve. The internal lateral ligaments are then divided. The ***radial incision***

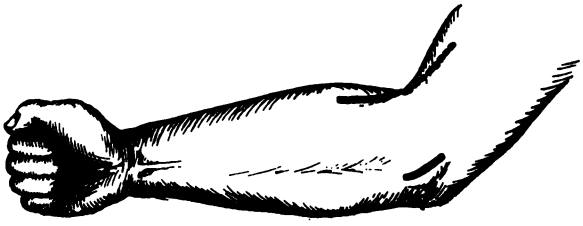

FIG. 23.—EXCISION OF THE ELBOW: LONG RADIAL INCISION.

proper consists of a vertical incision commencing about 2 inches above the external condyle, and carried downward well below the head of the radius; the lateral ligament is divided and head of the radius removed. With an elevator the soft parts are separated from the front and back of the joint. The ends of the bones are turned out of the radial incision and removed.

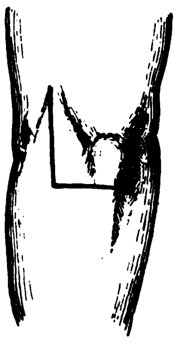

FIG. 24.—EXCISION OF THE LEFT ELBOW: LONGITUDINAL AND TRANSVERSE INCISION.

3. Longitudinal and Transverse Incision (Fig. 24).—Here a longitudinal incision is begun on the outer border of the humerus between the triceps and supinator longus about 2 inches above the olecranon, and is carried down for about 3 inches. A transverse incision is next made from the lower end of the first incision across the ulna to the inner border of the arm. The triangular flap is dissected up.

The external lateral and orbicular ligaments are divided and the head of the radius removed; the other bones are then turned out of the incision and removed.

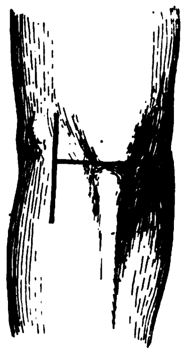

FIG. 25.—EXCISION OF THE ELBOW: H-SHAPED INCISION.

4. H-shaped Incision (Fig. 25).—This consists of two incisions, the long limbs of which commence about 2 inches above the olecranon and are continued downwards for 3 inches. These cuts fall over the radius and ulna respectively, and a transverse cut which joins the centre of these just above the olecranon completes the incision.

THE SHOULDER-JOINT.

ANATOMY.

Above.
Deltoid.
Supraspinatus.

Outer Side.
Infraspinatus.

(Joint).

Inner Side.
Subscapularis.

Below.
Long head of triceps.

Notice the groove between the deltoid and pectoralis major at the front of the joint. In this groove runs the cephalic vein and the acromio-thoracic artery. Just under the outer third of the clavicle, and again between the fibres of the deltoid and pectoralis major, can be felt the coracoid process of the scapular.

In thin subjects, with the arm slightly rotated outwards—that is to say, in the anatomical position—the groove for the tendon of the biceps and the tendon lying in it can be felt. The tip of the acromion can be felt overhanging the joint.

Excision of the Shoulder.

Operations.

1. Anterior incision (Ollier).
2. Vertical incision (von Langenbeck).
3. Posterior incision (Stromeyer).
4. Deltoid flap.

Of all these various incisions to expose the shoulder-joint, the anterior one is the best, as it does not divide the trunk of the circumflex nerve which is supplying the deltoid. Only the terminal fibres are divided, and thus the motor nerve-supply to the deltoid is not injured.

1. Anterior Incision (Fig. 26).—The patient should be lying on the back, and rolled slightly over on to the sound side. The surgeon stands at the shoulder, facing the patient. The arm being kept to the side, an incision about 3 to 4 inches long is commenced just under the tip of the coracoid process, and is carried downwards in the line of the arm. The skin, fascia and the deltoid muscle are divided freely, and retractors are inserted to hold apart the edges of the wound. The arm is then strongly rotated outwards, the bicipital groove sought for, and the tendon, if healthy, carefully separated from the groove and drawn inwards. The arm being still strongly rotated outwards, the capsule of the joint is opened towards the front, and the tendon of the subscapularis muscle divided. Then the arm is slowly rotated inwards, and the supra- and infraspinatus and teres minor tendons are in turn divided. The capsule being sufficiently freely opened, the head of the bone can be pushed up out of the socket and the diseased bone removed with a saw. If there is any difficulty in getting the arm out of its socket, a grooved director can be passed beneath the head, and the sawing can be done on to the director. The advantage of the director is that it keeps the soft parts out of the way. The glenoid cavity must lastly be turned to, and any diseased bone removed.

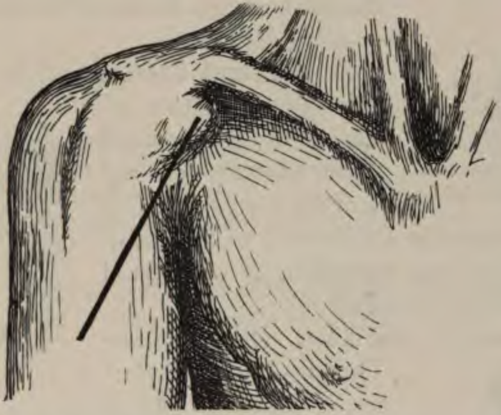

FIG. 26.—EXCISION OF THE SHOULDER: ANTERIOR INCISION.

Memoranda.

I. Avoid the cephalic vein where it lies between the deltoid and the pectoralis major.

II. Do not injure the tendon of the biceps unless diseased.

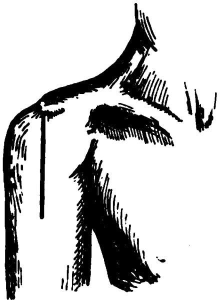

FIG. 27.—EXCISION OF THE SHOULDER: VERTICAL INCISION.

III. Do not remove more bone than is necessary.

IV. If a large portion of bone has to be removed, as the axillary vessels are close to the bone on the inner side of the arm, care should be taken to avoid wounding them.

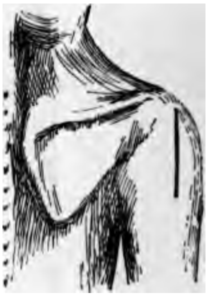

FIG. 28.—EXCISION OF THE SHOULDER: POSTERIOR INCISION.

2. Vertical Incision (Fig. 27).—In this operation the incision is commenced from the tip of the acromion, and is carried downwards for about 3 to 4 inches.

The rest of the operation is completed in the same way as above.

3. Posterior Incision (Fig. 28).—This is a vertical posterior incision. It is commenced at the posterior part of the acromion process, and carried downwards and outwards about 3 inches. The operation is completed as before.

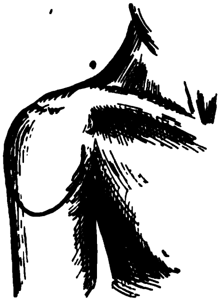

FIG. 29.—EXCISION OF THE SHOULDER: DELTOID FLAP.

4. Deltoid Flap (Fig. 29).—This consists in cutting a large flap, including the skin and deltoid, the base of the flap being upwards. The flap is commenced just below the coracoid process, and ends just below and to the back of the acromion.

CHAPTER IV

AMPUTATIONS OF THE UPPER EXTREMITY

THE FINGERS.

Anatomy.

WITH the fingers flexed, the knuckle of the terminal joint is represented by the head of the second phalanx. The knuckle of the second joint is represented by the head of the first phalanx, and therefore the joint lies below the knuckle.

Amputations of the Finger through the Terminal Joint.

Operations.

1. Long palmar flap.
2. Long dorsal flap.
3. Two equal or unequal anterior and posterior flaps.
4. Two lateral flaps.
5. External flap.

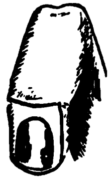

FIG. 30.—AMPUTATION OF THE TERMINAL PHALANX BY SINGLE PALMAR FLAP.

The best method of amputating at the terminal joint is by the *long palmar flap* (Fig. 30). This is performed in the following way:

The hand being pronated, and the other fingers held out of the way, the surgeon grasps the terminal phalanx, flexes it strongly, and with a long thin knife opens the joint by an incision slightly concave downwards. In this cut the lateral ligaments should be divided. The joint being freely opened, the blade of the knife is passed behind the base of the terminal phalanx and made to cut outwards, making an anterior flap about two-thirds the length of the pulp of the finger.

Memoranda.

I. Keep sufficiently low down in making the first cut so as to open the joint at once.

II. Cut the anterior flap long enough and round at its extremity.

III. While cutting the flap, the edge of the knife should be kept close to and parallel with the palmar surface of the bone.

Amputations of the Fingers through the Second Joint.

Operations (Figs. 31, 32).

These may be performed by any of the above-mentioned methods; but, if possible, it is wiser to amputate through the second phalanx rather than through the joint, and to illustrate such an amputation—that is to say, through the phalanx—the method of amputation by *anterior and posterior flaps* will be described. The surgeon, determining where he will divide the bone, cuts from without inwards—that is to say, not by transfixion. Starting on one side of the bone, he carries the knife

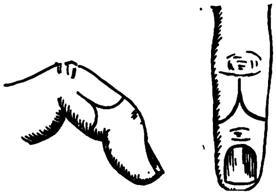

FIG. 31.—AMPUTATION OF THE FINGER THROUGH THE SECOND JOINT BY ANTERIOR AND POSTERIOR FLAPS AND BY LATERAL FLAPS.

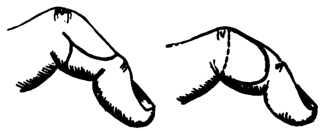

FIG. 32.—AMPUTATION THROUGH SECOND JOINT BY LONG DORSAL FLAP AND BY LONG EXTERNAL FLAP.

across to the other side, and so cuts a nicely-rounded dorsal flap, which is about half the circumference of the phalanx. All structures are firmly divided to the bone, and then dissected a little upwards. Then the point of the knife is entered at one side of the base of the dorsal flap, the knife passing under the bone—that is to say, on its anterior surface—and emerges at the opposite angle of the dorsal flap; then by a gentle sawing motion the palmar flap is cut. This must be made a little longer than the dorsal one. The flaps are retracted, the knife swept round the bone on a level with the base of the flaps, and the bone is divided by a saw or bone forceps.

Memoranda.

I. The fibrous sheath of the tendon is opened in amputation through the proximal phalanges. The sheath should be closed by a suture passed through it and the neighbouring soft parts, or through the periosteum so as to close the rigid canal.

II. When possible in the amputation of the fingers, let the scar be on or near the dorsal aspect of the stump.

III. Leave as much of the second phalanx as possible, so that the tendon may adhere to it. If the amputation is through the second joint, when possible fix with a stitch the tendon on to the sheath, or stitch the stump of the flexor tendon to the extensor tendon over the end of the bone.

Amputations of the Index, Second, Third, and Little Fingers at the Metacarpo-Phalangeal Joints.

Anatomy.

A furrow across the anterior and lower part of the hand nearly represents the position of the metacarpal joints of the fingers, the joint being a little below the line. A little lower down is another transverse furrow; this does not correspond with the joints, and is much below them. By pressing into the clefts between the fingers, the transverse ligament binding the metacarpal bones together can be felt as a firm band. With the fingers flexed, the knuckles are represented by the ends of the metacarpal bones, and the joints are below these prominences.

Operations.

1. Oval method.
2. Lateral flaps.
3. Slight modification for little finger.
4. Slight modification for first finger.

The oval method is the easiest (Fig. 33). The hand is pronated, and the healthy fingers flexed and held out of the way, the diseased finger being extended. An incision is made on the dorsum, commencing about ½ inch above the knuckle, and is carried firmly downwards until it gets well on the base of the phalanx. Then the knife is made to diverge slightly to the left, and is carried firmly around the finger below the web; next across the palmar aspect round to the right side of the finger, and so round to meet the incision on the dorsal aspect of the finger slightly obliquely. The knife must be used firmly, so as to divide all the structures at once right to the bone all round. This done, the flap is dissected up—that is, freed from the first phalanx. The tendons are cut, if not already severed by the first incision. The finger is drawn to one side and the lateral ligaments divided, and then drawn to the other side and the other lateral ligaments divided. Lastly, by a little rotation of the fingers all remaining structures are freed and the member removed. Two digital arteries require ligature.

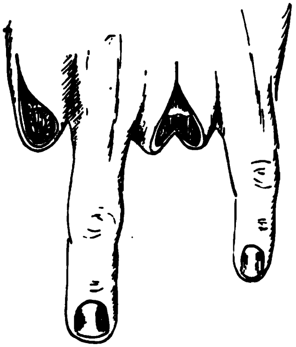

FIG. 33.—AMPUTATION OF FIRST AND RING FINGERS AT METACARPO-PHALANGEAL JUNCTION.

The amputation of the *index* finger is done in like manner, but, instead of the straight incision on the dorsum being used, an incision is commenced on the outer side of its metacarpal bone; and after the finger is removed, a piece of the head of the metacarpal bone is sawn off obliquely from above downwards, and from without inwards. In amputation of the *little* finger the incision should be commenced on the inner aspect of the metacarpal bone, and, in like manner, a piece of the head of the metacarpal bone should be removed from above downwards and from within outwards.

Memoranda.

I. The transverse line running across the lower part of the palm represents the level of the metacarpo-phalangeal joints.

II. The incision must not divide the web of the fingers, but must be carried below it.

III. If the head of the bone is removed, the transverse ligament is interfered with, and so the hand weakened, but a more sightly hand will result.

IV. When possible, suture up the sheaths of the flexor tendons.

THE THUMB.

Anatomy.

As in the fingers, so with the thumb when flexed, the knuckles are represented by the heads of the proximal bones, the joints being below the heads.

If the operator's finger is drawn along the dorsum of the thumb, the joint between the metacarpal bone and the trapezium can be felt.

At the back of the thumb is a hollow, which is known by the name of the 'anatomical snuff-box'; and when the thumb is extended the tendon of the extensor ossis metacarpi pollicis is to be seen, and to the inner side of this space is the tendon of the extensor secundi internodii pollicis. Under these tendons the radial artery runs into the deep part of the palm.

On the flexor aspect of the thumb at the metacarpo-phalangeal joint can be felt the two sesamoid bones, situated in the tendons of the flexor brevis pollicis.

Amputations of the Thumb at the Terminal Joint.

Operation.

This operation may be performed by one of the methods described for corresponding joints in the fingers. The best method for the terminal joint is probably the long anterior flap.

Amputations of the Thumb at the Metacarpo-Phalangeal Joint.

Operations.

1. Oval method.
2. Palmar and dorsal flaps.

These are performed as described for amputating the fingers.

Memoranda.

I. Cut the flaps long enough.

II. Leave the sesamoid bones in the anterior flap.

III. Sew up the flexor pollicis tendon to the sesamoid bone, and close the sheaths of the flexor tendon.

Amputations of the Thumb at the Carpo-Metacarpal Joint.

Operations.

1. Racket method.
2. Flap operation (transfixion).

1. The Racket Method is the simplest and best. The hand is held in a position midway between pronation and supination, the thumb is grasped by the operator, and the fingers held out of the way by the assistant. The point of the knife is inserted just above the carpo-metacarpal joint, which can be made out by its being the point into which the extensor ossis metacarpi pollicis is inserted. The knife is then drawn along the dorsum of the thumb up to the base of the first phalanx; then the knife is drawn around the thumb across the palmar aspect of the first phalanx below the web, and around once more to the dorsal incision. The edges of the dorsal cut are then taken hold of by the thumb and fingers of the operator, and dissected freely from the bone throughout its whole length. This, moreover, is facilitated by the assistant holding the flap, and the surgeon rotating the thumb first away from one flap and then from the other. As soon as the soft parts are freely separated and the tendons divided, the joint between the metacarpal bone and the trapezium is opened by putting the ligaments on the stretch and dividing them, first on one side, then on the other.

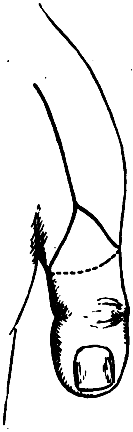

FIG. 34. — AMPUTATION OF THE THUMB: RACKET METHOD.

Memoranda.

I. Avoid wounding the radial artery as it crosses under the extensor tendon of the thumb to the deep part of the hand.

II. The incision round the first phalanx should be carried well below the web.

III. The sesamoid bones are at the metacarpo-phalangeal joint. They may or may not be removed as the case indicates. See that the knife does not become entangled between them and the bone.

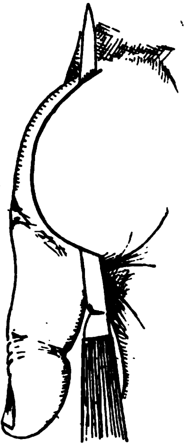

FIG. 35. — AMPUTATION OF THE THUMB; FLAP METHOD.

2. Flap Method (Fig. 35).—In operating on the *right* thumb, the knife is entered into the web between thumb and first finger, and the point is made to emerge at the carpo-metacarpal joint, and the flap cut outwards by transfixion; on the *left* side the knife is entered at the joint, and the point comes out at the web.

A large palmar flap is so cut, everything to the bone being divided. The metacarpal bone is then dissected from the remaining soft tissues, and lastly freed from its attachment to the trapezium. The arteries requiring ligature are the dorsalis pollicis and the princeps pollicis.

THE WRIST-JOINT.

Anatomy.

The styloid process of the ulna can be felt at the end of that bone, and it is worthy of remark that it does not extend to as low a level as does that of the radius. The radial styloid process not only extends lower than that of the ulna, but is situated more anteriorly. The relative positions of these two can be definitely appreciated by putting the thumb on one, and the index-finger of the same hand on the other.

Just below the styloid process of the ulna, but to the front of the joint, can be felt the pisiform bone. Below the styloid process of the radius can be felt the tubercle of the scaphoid.

The furrows on the anterior aspect of the wrist should be noted. The lowest indicates the *intercarpal joint*, the line of the wrist-joint proper being just above it, exactly on a level with the styloid process of the ulna, running outwards to the interval between the styloid process of the radius and the tubercle of the scaphoid.

Operations.

1. Long palmar flap.
2. Anterior and posterior equal flaps.
3. Dorsal flap by Teale's method.
4. Lateral flap.

The simplest, and at the same time the best operation is the first method.

1. Long Palmar Flap (Fig. 36).—The hand is held with the palmar surface upwards; a flap is then cut by the following method:

The incision is commenced from one of the styloid processes, and is carried down the palm over the muscles of the thumb or little finger to a point just below the position of the superficial palmar arch, which is on a level with the web of the thumb when extended. The direction of the incision is then across the palm to the other side of the hand, and from that again up the other eminence to the other styloid process. This incision divides the skin and cellular tissue. The flap is then carefully dissected up. When the flap has been well separated up to the styloid processes, the hand is turned over and a straight or slightly-curved incision is made across the back of the wrist on a level with the styloid processes. The skin is now retracted by the assistant, and the palmar flap kept well out of the way. The hand is held straight, and the knife drawn with a circular cut round the front, back, and sides of the wrist so as to divide all the soft parts right to the bones. The hand, now being only held to the forearm by the ligaments of the wrist, is pulled to one side, the lateral ligaments divided, the joint opened, and the member with a few touches of the knife is removed. The arteries to be secured are the radial, ulnar, interosseous, and probably the superficialis volæ. The tips of the styloid processes are as a rule removed, and, of course, more of the bones if diseased.

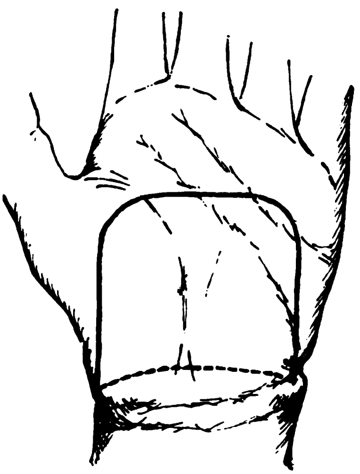

FIG. 36.—AMPUTATION AT THE WRIST: LONG PALMAR FLAP.

Memoranda.

I. The styloid process of the radius is on a lower level than that of the ulna.

II. The tip of the styloid process of the ulna represents the level of the wrist-joint.

III. When using the long palmar flap, carry the incision a little below the line of the superficial palmar arch, so that it is contained in the flap.

IV. Always take up plenty of cellular tissue and some muscle in the anterior flap.

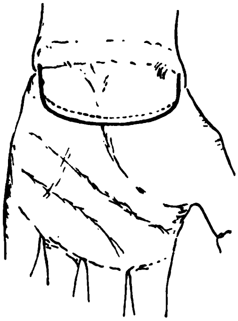

FIG. 37.—ANTERIOR AND POSTERIOR EQUAL FLAPS.

2. Anterior and Posterior Flaps (Equal) (Fig. 37).—The flaps are made of equal length on the anterior and the posterior surfaces of the wrist, the anterior flap being made about half the length of the flap made in the long palmar flap method.

3. Dorsal Flap of Teale consists of a long dorsal one, cut down to about the middle of the metacarpal bone. A short anterior flap is also made.

4. Lateral Flap (Fig. 38).—This operation is performed by cutting a lateral flap on the outer or inner side of the hand, which reaches to about the middle of the metacarpal bone of the little finger or thumb. This flap should be made sufficiently broad by commencing it towards the back of the hand and carrying it well round on to the palm. The flap is well retracted, and the hand is then removed by a circular cut around the wrist from one angle of the base of the flap to the other.

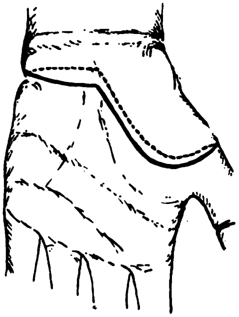

FIG. 38.—LATERAL EXTERNAL FLAP.

THE FOREARM.

Anatomy.

There are a few anatomical points to be remembered with reference to amputation of the forearm :

The ulna is subcutaneous throughout its entire extent, and can be felt anywhere.

The radius for the upper half is covered by muscles, and cannot be so easily felt; the lower half, however, is subcutaneous, and can be made out.

The pronator radii teres is inserted into the outer side of the middle of the radius; the bones are not fixed as in the leg, but movable.

Operations.

1. Anterior and posterior skin flaps, with circular division of the muscles.
2. Lateral flaps, with circular division of muscles.
3. Transfixion flaps.
4. Circular amputation.
5. Teale's amputation.

The forearm may be removed at the lower, middle, or upper thirds. Taken altogether, the best method is by the anterior and posterior skin flaps, with circular division of the muscles.

1. Anterior and Posterior Skin Flaps and Circular Division of the Muscles (Fig. 39) is performed in the following manner: The patient's arm is held from the side and pronated; the surgeon stands on the right-hand side of the limb to be removed. The finger and thumb of his left hand are placed on the limb at the position at which the bones are to be sawn through. The incision is commenced on the outer side of the arm, about an inch below the position of the surgeon's left finger. The incision is carried downwards for about 2 inches, and then turned straight across the limb to the other side, and up the other side of the limb to about an inch below the position of the operator's thumb. This flap is then dissected up, care being taken to retain all the cellular tissues, and even a little of the muscle. The arm is next raised by the assistant so that the anterior or palmar aspect is presented to the operator, and a flap a little shorter than the former is cut on the anterior surface by joining the two horns of the other incision. This is in like manner dissected up. These flaps are then everted and are both retracted firmly; the soft parts are divided by a circular division of the muscles down to the bone on a level with the angle of the flaps. This is just an inch in front of the place where the thumb and finger of the left hand rest on the point at which the bones are to be divided. Then the muscles are retracted together with the flaps, and the bone divided on a level with the position of the thumb and fingers of the operator. The bones are carefully cleared by a few sweeps of the knife, which is passed between them to sever the interosseous membrane.

This being completed, the bones are sawn through. The vessels requiring attention are: The radial, under the supinator longus; the ulnar, under the flexor carpi ulnaris; the anterior interosseous, on the membrane; and the posterior interosseous, between the superficial and deep muscles at the back of the forearm.

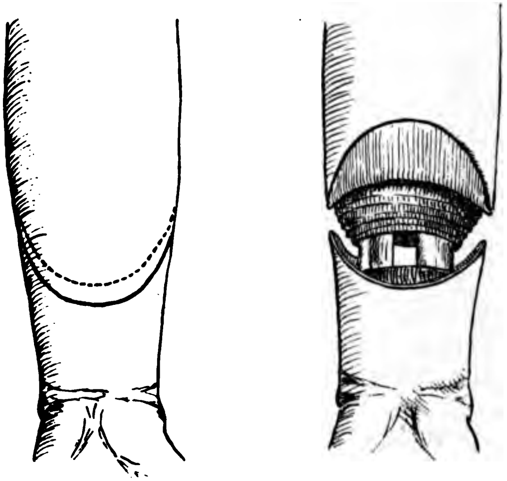

FIG. 39.—AMPUTATION OF THE FOREARM. ANTERO-POSTERIOR SKIN FLAPS, WITH CIRCULAR DIVISION OF MUSCLES.

Memoranda.

I. If possible, amputate in the lower or middle third of the arm, so as to be below the insertion of the pronator radii teres (which is inserted into the middle of the radius), as the noninterference with this muscle greatly facilitates pronation of the stump.

II. Cut all nerves and tendons short in the flaps.

III. Commence the incision about an inch below the places where the bones are to be divided. By this device the bones are prevented from protruding from the external aspect of the flaps, which may take place if the incision for the flaps is commenced on a level with the point of division of the bones.

IV. In sawing the bones through, hold the limb supinated, so as to keep the bones as parallel as possible, and divide them together at the same time with the saw.

2. **Lateral Flaps.**—This operation is performed in the same manner as the previous operation, except that the flaps are lateral instead of being antero-posterior.

3. **Transfixion Flaps** are made as follows: The knife enters on one side of the limb, and, passing across the bones, emerges at the other side. The structures are cut from within outwards.

4. **Circular Amputation** is performed, as in other regions, by a circular cut through the skin, which is then retracted; then the muscles are divided with a circular sweep, retracted, and finally the bones are severed.

5. **Teale's Method**, executed by a very long anterior or very long posterior flap with skin alone, or with muscles included in the flap.

THE ELBOW-JOINT.

Anatomy (Fig. 21).

The internal and external condyles of the humerus can be easily felt.

The internal condyle is nearly ½ inch lower than the external, and is also more to the front of the joint.

With the arm slightly flexed, a crease can be seen at the front of the elbow; this is a little above the line of the joint.

At the back of the joint the olecranon can be felt. This is a little nearer to the inner than to the outer aspect of the joint.

To the outer side of the olecranon, and just below the external condyle of the humerus, is a dimple which always exists, and represents the position of the head of the radius.

Operations.

1. Long anterior flap with short posterior.
2. Long anterior flap.
3. Long posterior flap.
4. Circular method.
5. Lateral flaps.

1. Long Anterior Flap with Short Posterior (Fig. 40).—The surgeon stands on the right side of the limb to be removed, which is held away from the side and completely supinated; he grasps the soft parts in front of the elbow triangle, transfixes the tissues so raised by inserting the knife about an inch below the condyle nearest him, and allows the point to emerge just below the other condyle. A well-rounded flap is then cut about 3 inches long, the skin being cut longer than the muscles. The posterior flap is then cut by an incision commencing at the side of the base of the anterior flap, and passing across the olecranon to the other side. This posterior flap should be convex, and about 1½ inches in length. It is carefully dissected up, keeping the edge of the knife close to the bone while separating it from the olecranon. The flaps are then retracted, any remaining structures are divided down to the bone, and the elbow-joint opened at the outer side, by inserting the knife into the radio-humeral joint.

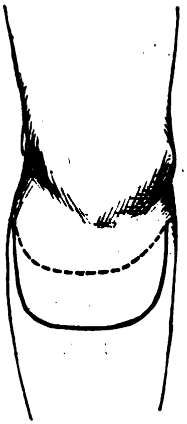

FIG. 40.—AMPUTATION AT THE ELBOW BY LONG ANTERIOR AND SHORT POSTERIOR FLAPS.

The radial and ulnar arteries are to be found in the anterior flap superficially; deeply, the interosseous artery. The superior profunda is in front of each condyle, and the inferior profunda behind each condyle.

Memoranda.

I. Open the joint from the outer side, as the radio-humeral joint is so easily found.

II. Remember that the internal condyle is lower than the external condyle.

2 and **3. The Long Anterior Flap and the Long Posterior Flap** are merely slight modifications of the previous operation.

4. The Circular Method is done by a circular incision through the skin, commencing about 3 inches below the elbow-joint while the forearm is extended. A sleeve of skin is turned back to the level of the joint, the muscles are divided, and the joint opened.

5. Lateral Flaps.—The skin flaps are commenced from the centre of the anterior and posterior aspects of the limb, and are cut from the sides of the forearm, being made about 2 or 3 inches in length.

THE ARM.

Anatomy.

The deltoid is inserted into the middle and outer part of the arm. It is here also that the musculo-spiral nerve passes into its groove, and the nutrient artery enters the bone and runs downwards.

Operations.

1. Circular method.
2. Skin flaps, antero-posterior or lateral, with circular cut through the muscles.
3. Skin flaps, with transfixion of muscles.
4. Skin and transfixion combined.
5. Single anterior flap.

Of all these amputations, the circular method is probably the best, as it so so well adapted to the region.

1. Circular Method.—The arm is held from the side, and the surgeon stands on the right of the limb; he then with the left hand pulls up the skin above the site of removal of the limb. The hand with knife is put under the limb and around it, so that the base of the blade is ready to commence the incision as near as possible to the operator; then with a sweep the knife is brought around the limb to the point where the incision was started. The completion of the incision in one cut is aided by the assistant rotating the arm. The sleeve is dissected up to a point on a level with the intended line of division of the bone. The cellular tissue and as much as possible of the deep fascia should be taken up with the skin. This cuff is raised to about the extent of 3 inches, and is folded back if possible. The muscles are next divided by a similar circular cut about an inch from the back of the skin flap. These muscles are then retracted, and the remaining soft tissues are divided to the bone at a little higher level. Lastly, the periosteum of the bone is divided, and the bone is sawn through well up to the level of the base of the skin cuff.

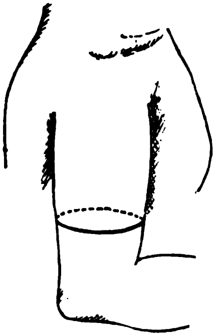

FIG. 41.—AMPUTATION OF ARM BY CIRCULAR METHOD.

Memoranda.

I. If the amputation is near the middle of the arm, seek for the musculo-spiral nerve in its groove in the humerus, free it from the latter, and cut it short. If it is not short it may become involved in the callus of the stump and cause great pain.

II. Whenever it is possible, amputate below the middle of the arm; there is then no interference with the insertion of the deltoid or the pectoralis major, which are important muscles in the after-movement of the stump.

2. Skin Flaps, Antero-Posterior or Lateral, with Circular Cut through the Muscles. — The skin flaps are cut about 3 inches long, and then the muscles divided circularly.

3. Skin Flaps, with Transfixion of Muscles.—The same method as above, except that the muscles are transfixed instead of being circularly divided.

4. Skin Flap and Transfixion combined.—The soft parts are lifted in front of the bone and transfixed, the knife carefully carried *in front* of the brachial vessels. A well-rounded flap is then cut about 3 inches long, the skin being cut longer than the muscles. The flap is then slightly raised, and the knife passed behind the bone at the base of the anterior flap; the posterior flap is then cut, and the bone is cleared and sawn through on a level with the base of the flaps.

In any transfixion operation, mind not to transfix the brachial vessels. Let them always be well behind the anterior point of transfixion—that is to say, be contained in the posterior flap.

5. Single Anterior Flap.—This is a long anterior flap about 4 to 5 inches in length.

THE SHOULDER-JOINT.

Anatomy.

The points of importance in amputation of the joint are: At the back of the joint can be felt the spine of the scapula, terminating in the acromion process, which overhangs the shoulder-joint. Just below the acromion, the arm being to the side, can be felt the great tuberosity; this is situated on the outer part of the head of the bone; a little below this, and to the front of the joint, is the lesser tuberosity. It is worthy of note that the great tuberosity faces in the same direction as the external condyle of the humerus.

With the arm hanging by the side, the groove between the deltoid and pectoralis major can generally be made out towards the front of the joint.

Near the groove, and a little below the clavicle, can be felt the coracoid process of the scapula.

The anterior fold of the axilla can be seen, and is formed by the lower border of the pectoralis major.

The posterior border of the axilla is formed by the latissimus dorsi and subscapularis muscles.

The line of the axillary artery can be represented by a line drawn from the centre of the clavicle down to the insertion of the deltoid, the limb being held away from the chest.

Operations.

Mr. Jacobson says there are thirty-six different methods of removing the arm. It would be out of place in a work of this size to describe all. The following are the principal methods:

1. External and internal flaps.
2. External or deltoid flap.
3. Spence's method.
4. Anterior and posterior flaps.
5. Furneaux-Jordan's method.

Before commencing this important amputation, it is necessary to enumerate the ways by which the bleeding may be controlled, as this is more difficult than in most other regions, where the ordinary tourniquet is sufficient:

1. Securing the vessels before dividing them in the inner flap. This is the best method, and is easily done. When the flaps are cut ready to disarticulate, the axillary vessels are easily found and secured.

2. The assistant following the knife with his hands when the inferior or anterior flap is being cut. This is safe with a reliable assistant.

3. Pressure on the subclavian artery, which may be assisted by an incision through the skin in fat necks.

1. External and Internal Flaps. — If possible, two assistants should be in attendance—one to manipulate the limb, and the other to grasp the vessels in the inner flap. The patient is brought well to the edge of the table, and is slightly rolled on to the sound side, and the surgeon should stand on the right side of the limb to be removed—that is to say, outside the right limb and inside the left. The arm is raised from the side. The surgeon cuts a large deltoid skin flap, commencing just below the coracoid process, and ending just below and to the back of the acromion, or *vice versâ*. A large external skin flap is then dissected upwards to its base. This is retracted. The muscles about the joint are divided by the arm being forcibly rotated inwards and then rotated outwards while the knife is over the joint; by this manœuvre the muscles passing to the great tuberosity are divided. The joint is then opened, the head of the bone is pushed out of the socket, and the knife is passed behind it and made to cut its way out through the tissues on the inner side of the humerus. The assistant follows the knife with his hands, and grasps the flap so as control the vessels before the knife is made to cut out. The internal flap is made half the length of the external one.

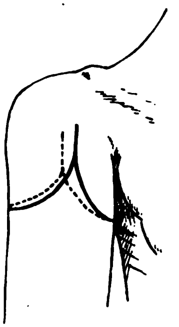

FIG. 42. — AMPUTATION AT THE SHOULDER BY INTERNAL AND EXTERNAL FLAPS.

The vessels which generally require securing are the axillary, subscapular, the circumflex, and smaller vessels (some more, some less, in the different methods of amputation).

Memoranda.

I. Cut the flaps long enough and broad at their extremities.

II. Take care to divide the tissues *below the point* at which the axillary artery has been secured, if this is the method employed in securing the axillary artery.

III. If the axillary artery is not secured previous to completing the amputation, do not be precipitate in cutting the internal flap; when the head of the bone is well freed from its socket, and the knife has cut a little of the internal flap, see that the assistant has well grasped the flap behind the knife with his thumb and finger before you cut the flap free from the bone.

IV. Be careful not to include any nerves in the ligature of the axillary artery.

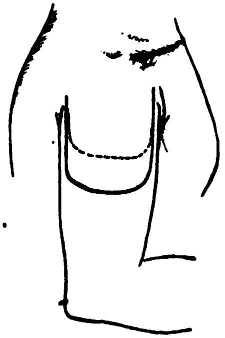

FIG. 43.—AMPUTATION AT THE SHOULDER BY EXTERNAL OR DELTOID FLAP.

2. Amputation by External Flap only (Fig. 43).—This is the same as the previous amputation, with the exception that here there is practically no inferior flap. The deltoid flap has to be made very large.

3. Spence's Method (Fig. 44) is done in the following manner. A vertical incision is made from just outside the coracoid process down to the insertion of the pectoralis major, this structure being divided at once in the incision. Then the knife is turned outwards, and all the structures divided to the bone as far as the back of the arm. Another incision, only skin deep, is made from the lower end of the vertical cut around the inner side of the arm, to join the deep outer incision. The large external flap containing the deltoid is then pulled up by the hand, and the head of the bone is exposed, the muscles attached to it divided, and the joint freely opened. The knife is then passed behind the head of the bone, and made to cut its way out through the anterior or inner skin incision close to the bone.

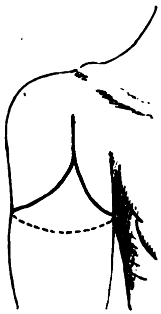

FIG. 44.—AMPUTATION AT THE SHOULDER BY SPENCE'S METHOD.

4. Amputation by Anterior and Posterior Flaps (Fig. 45).—The operator grasps the arm and draws it from the side. The knife is inserted with the edge towards him, just in front of the *posterior* fold of the axilla, and is thrust upwards, passing *behind* the neck of the humerus, and emerging as near to the acromion as possible. A flap about 4 inches long is cut from the posterior part of the humerus. This is grasped and retracted; the arm is then drawn across the chest, and the muscles about the joint are divided and the joint opened. The knife is then passed behind the head of the humerus to the front of the head, and the arm being brought to an abducted position, the anterior flap is cut.

5. Furneaux-Jordan's Method.—A circular amputation is made round the arm, about 3 inches below the shoulder-joint, the bone is divided, and the vessels are ligatured. Then a vertical incision is made along the upper part of the stump to the acromion down to the bone. The parts are pulled asunder, the remaining portion of the humerus is seized by lion forceps, the muscles about the joint are divided, and the head and remaining part of the humerus are dissected out.

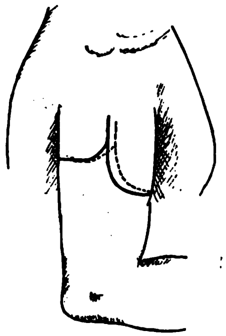

FIG. 45.—AMPUTATION AT THE SHOULDER BY ANTERIOR-POSTERIOR FLAPS.

SCAPULA.

Amputation of the Scapula by Itself.

Operation (Fig. 46).

The patient is placed at the edge of the operating-table, and rolled over to the sound side. The subclavian artery is controlled by pressure, this being facilitated by a skin incision which allows the pressure to be exerted directly upon the vessel. An incision is then made from the tip of the acromion backwards along the spine of the scapula to the vertebral border. Then another longer incision is made down the vertebral border at right angles to the first, and is extended upwards above the superior angle for about 3 inches. The flaps are then dissected back. The muscles attached to the vertebral border are divided, and the posterior scapular artery is secured. The vertebral border of the scapula is next made prominent, and the serratus magnus divided. Next, the muscles attached to the superior border are freely divided, and the suprascapular artery is secured. The acromio-clavicular joint is then opened, the scapula dragged away from the chest-wall, and the latissimus dorsi separated from the inferior angle of the bone. The axillary border is next exposed, the subscapular artery is felt by the finger, and secured prior to division of the teres and infraspinatus muscles. The muscles attached to the coracoid process are divided, this being facilitated by pressing the scapula well away from the chest. The shoulder-joint is opened and the triceps and biceps tendons divided.

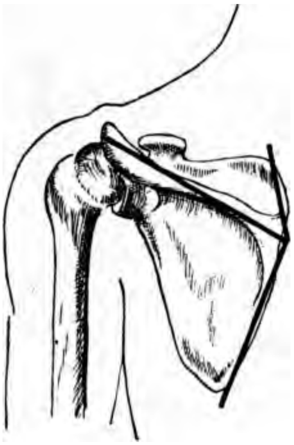
FIG. 46.—AMPUTATION OF THE SCAPULA BY ITSELF.

Memoranda.

I. Good pressure must be kept on the subclavian artery.

II. Deal last of all with the axillary border of the bone, and be careful to secure the subscapular artery before dividing it.

III. The skin incision must be made large enough, so as to expose the parts clearly.

Removal of the Upper Extremity with the Scapula.

Operation (Fig. 47).

The patient being in the same position as in the former operation, an incision is made along the outer third of the clavicle, the axillary artery and vein are exposed and ligatured separately. The clavicle is then sawn through at the junction of the middle and outer thirds. An incision is next made from the outer end of the clavicle, and carried down across the front of the upper part of the arm, across the axilla towards the inferior angle of the scapula. The posterior flap is then cut from the outer end of the clavicular incision across the back of the arm, and down to the same point at the inferior angle of the scapula. These flaps are retracted and held out of the way by an assistant. The muscles about the vertebral and superior borders of the scapula are divided, and the posterior scapular and suprascapular arteries secured. Attention is now turned to the front of the limb; the pectorales major and minor, the axillary vessels, brachial plexus, and latissimus dorsi are all divided. A few touches of the knife complete the operation.

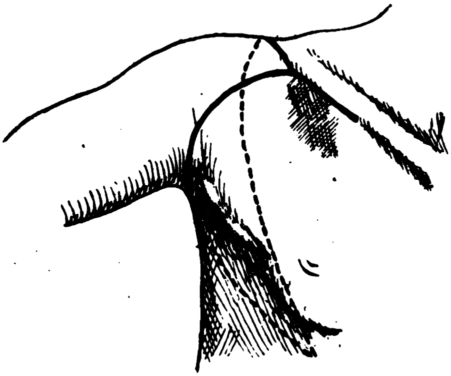

FIG. 47.—AMPUTATION OF THE UPPER EXTREMITY WITH THE SCAPULA.

Memoranda.

I. Secure carefully all bleeding-points in the flaps, so as to prevent any oozing of blood.

II. Apply good pressure when dressing the stump, so as to diminish as much as possible the serous oozing, which is considerable in such a large amputation.

CHAPTER V

PLASTIC OPERATIONS AND OSTEOTOMIES UPON THE UPPER EXTREMITY

WEBBED FINGERS.

Operations.

1. Didot's operation.
2. Norton's operation.
3. Ring method.

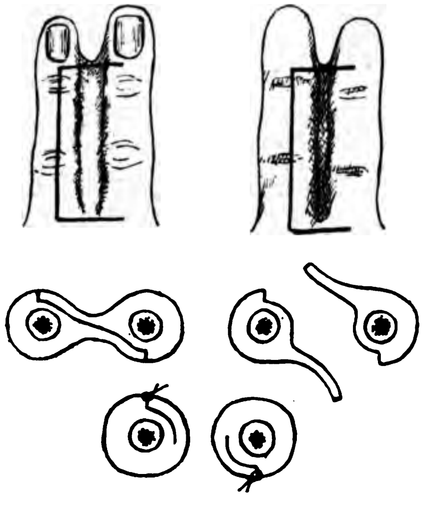

FIG. 48.—DIDOT'S OPERATION FOR WEBBED FINGERS.

The arrangement of the flaps is shown in cross-section below.

1. Didot's Operation (Fig. 48).—From the palmar and dorsal aspect of the web two longitudinal flaps are cut, the one on the palmar aspect having its attachment to, say, the first finger, and the one on the dorsal aspect of the web having its attachment to the second finger. These flaps are separated and made to surround their respective fingers, viz., the flap attached to the first finger surrounding it, and the one attached to the second finger surrounding that.

Memoranda.

I. Dissect up the flaps right down to the base of the web.
II. Keep the flaps sufficiently thick.

2. Norton's Operation.—This consists of dissecting up small flaps at the base of the web—one on the palmar and the other on the dorsal aspect of the hand—then dividing the remainder of the web, and lastly sewing the anterior and posterior flaps together.

Memoranda.

I. Cut the flaps long enough.

II. See that they include some cellular tissues, and are not too thin, for fear of sloughing.

3. Ring Method.—Perforate the base of the web, and let the patient wear a silver ring or wire in the hole so made, until it has soundly healed, then divide the web and keep the fingers apart while each side of the cut heals.

CONTRACTED PALMAR FASCIA (DUPUYTREN'S CONTRACTION).

Operations.

1. Subcutaneous method (Adam's).
2. Open method.

1. Subcutaneous Method.—The contracted bands of fascia are made tense, and a fine tenotomy knife is insinuated between the skin and fascia, the edge of the blade is turned towards the fascia, and the band or bands divided. Several separate punctures are generally necessary in order to divide all the fascial bands. After all obvious bands have been attended to the fingers are extended, and any tense fibres that have been overlooked should then be divided.

Memorandum.

Be careful not to tear the skin when extending the fingers.

2. Open Method—V-shaped Incision.—A V-shaped incision is made, with the base of the V opposite to and above the root of the contracted finger. The arms of the incision are carried right through the skin and fascia. The finger is next straightened, and the incision stitched up in the form of a Y. Some prefer to turn up a skin flap, and then to dissect away the contracted fascia.

EXCISION OF THE METACARPAL BONES OF THE FINGERS.

Operation.

An incision is made along the dorsal aspect of the metacarpal bone rather to one side, so as to avoid the extensor tendon. The tendon is pulled on one side. The periosteum of the metacarpal bone is freed by an elevator as much as possible along its entire length; the bone is then divided about its centre with bone forceps. The upper end is seized with lion forceps, lifted up, freed and removed; the lower fragment is removed in the same way.

EXCISION OF THE METACARPAL BONE OF THE THUMB.

Operation.

The incision is made along the outer side of the metacarpal bone, starting over the trapezium and ending over the first joint. The periosteum is separated, the bone disarticulated at the lower end and seized with forceps. The soft parts are separated, and the bone removed.

Memoranda.

I. Keep well to the outer side of the dorsal aspect so as to avoid the extensor tendons.

II. Do not commence the incision too near the wrist for fear of wounding the radial artery as it dips into the hand.

III. Leave as much periosteum as possible.

EXCISION OF THE ULNA.

Operation.

An incision is made along the posterior aspect of the bone, and continued a little upwards and outwards between the triceps and anconeus muscles. When all the periosteum is separated from the bone, it is sawn in half in the middle and removed in two pieces.

EXCISION OF THE RADIUS.

Operation.

An incision, involving only skin at first, is made along the outer border of the radius from the styloid process to the radio-humeral joint. The fascia is divided, and the posterior border of the supinator longus is found. The periosteum is then separated and the supinator brevis divided; the bone is sawn through about its centre and removed.

Memoranda.

I. Find the posterior edge of the supinator longus. If this is done, the extensor tendons of the thumb are avoided.

II. Higher up, the interval between the supinator longus and the extensor carpi radialis must be found.

THE HUMERUS.

Excision of the Upper Third of the Humerus.

Operation.

This is best performed by the same incision as Ollier's (Fig. 26) for excision of the shoulder-joint, but it is prolonged farther downwards.

Excision of the Middle Third of the Humerus.

Operation.

This is performed by an incision made along the posterior border of the deltoid and the outer edge of the biceps.

Memorandum.

Do not wound the musculo-spiral nerve, which is passing across the posterior part of the humerus to its outer side.

Excision of the Lower Third of the Humerus.

Operation.

An incision is made along the outer side of the posterior aspect of the arm between the triceps and supinator longus muscles.

EXCISION OF THE CLAVICLE.

Operation.

An incision is made along the entire length of the anterior surface of the clavicle. The periosteum is stripped from the bone. The bone is then sawn through the middle, and each portion removed.

Memorandum.

Care must be taken in removing the inner fragment as the subclavian vessels are just behind it.

PART II

CHAPTER I

LIGATURE OF THE ARTERIES OF THE LOWER EXTREMITY

DORSALIS PEDIS ARTERY.

The line of the artery is from the centre of the ankle-joint to the upper part of the first interosseous space.

Ligature of the Dorsalis Pedis Artery.

Anatomy (Fig. 49).

In Front.

Skin and small veins.
Branches of anterior tibial and musculo-cutaneous nerves.
Tendon of extensor brevis.

Outer Side.		*Inner Side.*
Anterior tibial nerve. Extensor longus digitorum.	[Artery.]	Extensor longus pollicis tendon.

Behind.

Astragalus, scaphoid and internal cuneiform bones.

Operation (Fig. 50).

The operator stands on the right side of the limb, an incision about 2 inches long is made, with the foot extended, in the course of the vessel, about 1½ inches below the ankle-joint. The skin and fascia are opened up, the tendon of the flexor longus pollicis is exposed, and just to the outer side of this,

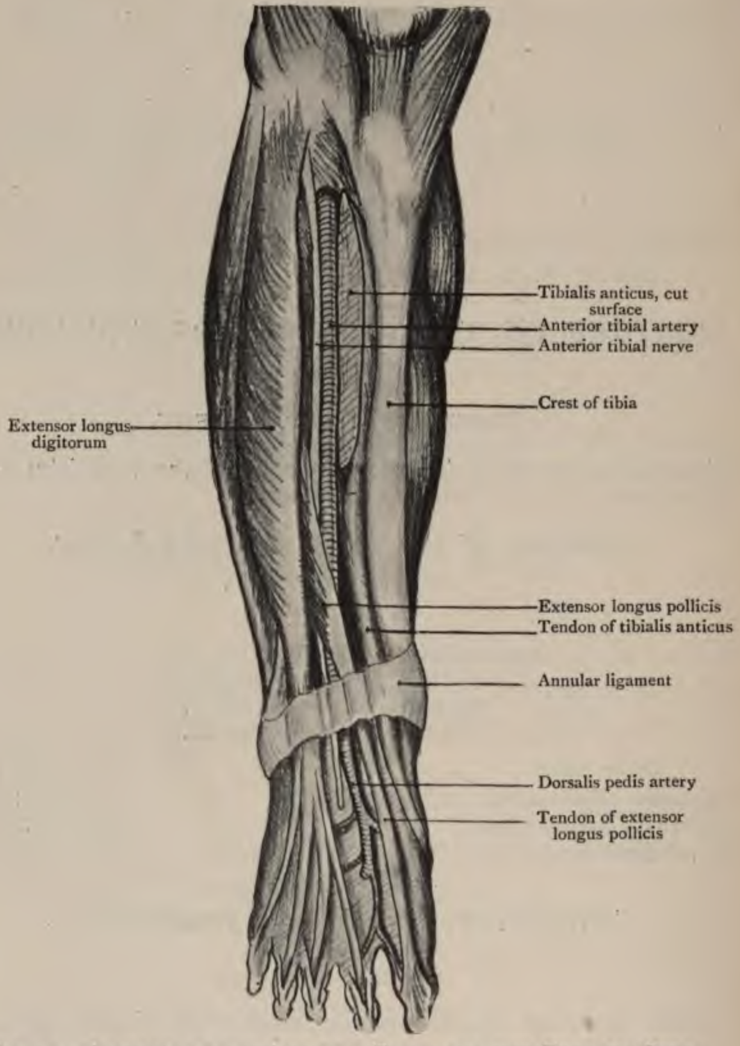

FIG. 49.—ANATOMY OF THE ANTERIOR TIBIAL AND THE DORSALIS PEDIS ARTERIES.

between it and the tendon of the extensor longus digitorum, the artery will be found. The extensor brevis tendon may be seen, and should be drawn outwards. The vessel is freed and the ligature passed.

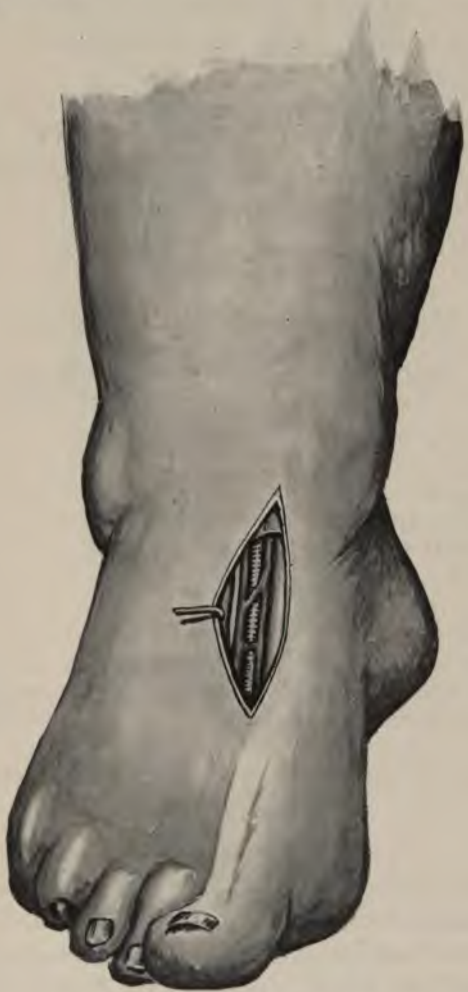

FIG. 50.—LIGATURE OF THE DORSALIS PEDIS ARTERY.

The artery is shown surrounded by its venæ comites, and with the extensor longus pollicis on the inner side, and the anterior tibial nerve and tendon of the extensor longus digitorum on the outer side.

Memoranda.

I. Be careful to open freely the fascia covering the artery.

II. Do not open the synovial sheaths of the tendons.

III. If the branch of the musculo-cutaneous nerve is seen, avoid dividing it.

ANTERIOR TIBIAL ARTERY.

The line of the artery is from a point over the tibulo-fibular joint to a point midway between the malleoli.

ANATOMY (Fig. 49).

In Front.

Skin, fascia, superficial veins, and nerves.
Tibialis anticus.
Extensor longus digitorum (upper part).
Extensor longus pollicis (lower part).

Outer Side.		*Inner Side.*
Anterior tibial nerve. Extensor longus digitorum (upper part). Extensor longus pollicis (lower part).	**[Artery.]**	Tibialis anticus.

Behind.

Interosseous membrane.

This artery can be ligatured in any part of its course, but the usual places chosen are at the junction of the upper and middle thirds and at the junction of the lower and middle thirds of leg.

Ligature of the Upper Part of the Anterior Tibial Artery.

Operation (Fig. 51).

The surgeon should stand on the outer side of the limb to be operated upon, the leg is extended and turned well inwards. An incision is made, 4 inches long, directly over the course of the vessel, commencing about 2 inches below the head of the tibia. The fascia is carefully divided, the interval between the tibialis anticus and the flexor longus digitorum is looked for. This interval is opened up with the

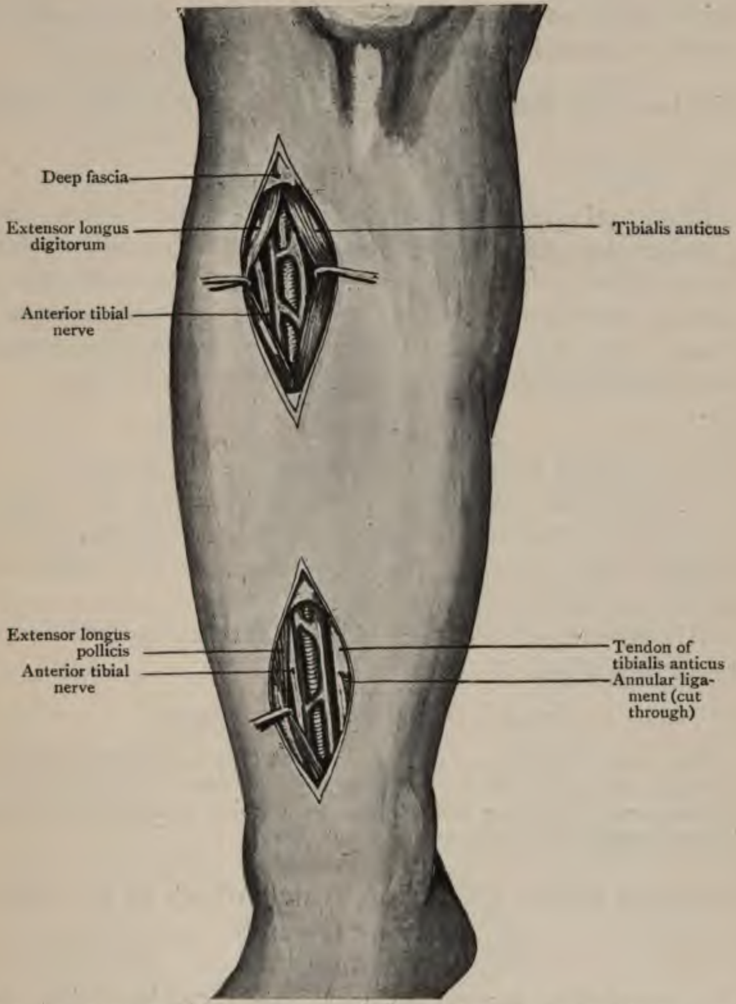

FIG. 51.—LIGATURE OF THE ANTERIOR TIBIAL ARTERY IN THE UPPER AND LOWER THIRDS OF THE LEG.

fingers and the handle of the knife. The muscles are well retracted, and the artery will be discovered surrounded by cellular tissue situated on the interosseous membrane, the nerve being on the outer side. The artery is freed and the aneurism needle is passed from without inwards.

Ligature of the Lower Part of the Anterior Tibial Artery.

Operation (Fig. 51).

Here, again, as in the former operation, the incision, about 3 inches long, must be made directly in the course of the vessel, about an inch from the tibia. In this case the interval between the tibialis anticus and flexor longus pollicis must be found. The vessel is exposed on the interosseous membrane, the aneurism needle being passed from without inwards.

Memoranda.

I. Be careful to keep exactly in the line of the vessel.

II. When the skin and fascia are opened, the interval between the muscles may be known by a white line, or by an arterial twig coming up between them, or by a depression which may be felt with the finger.

III. Remember that the nerve is on the outer side of the vessel throughout its course.

POSTERIOR TIBIAL ARTERY.

The course of the artery is represented by a line starting about 2 inches below the bend of the knee-joint behind, in the centre of the leg, and extending downwards to a point midway between the internal malleolus and the tendo Achilles.

Ligature of the Posterior Tibial Artery at the Ankle.

ANATOMY (Fig. 52).

In Front.

Superficial skin and fascia and small nerves and veins.
Internal annular ligament.

Outer Side.		*Inner Side.*
Posterior tibial nerve. Flexor longus pollicis.	[Artery.]	Flexor longus digitorum.

Beneath.

Internal lateral ligament.

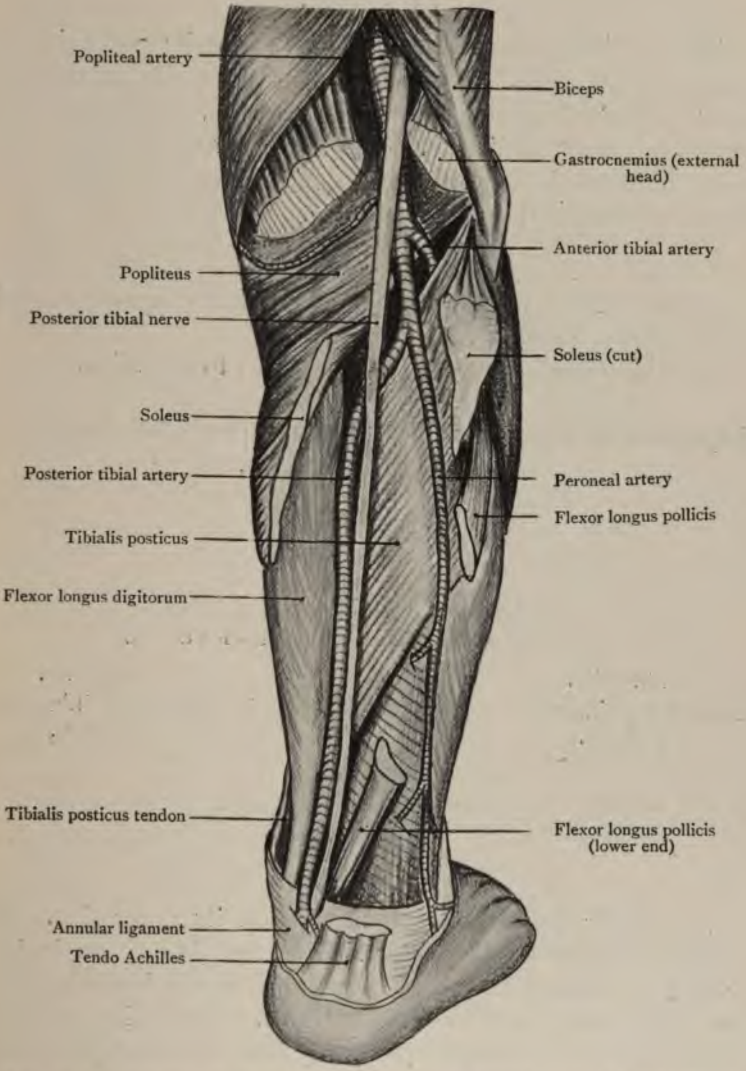

FIG. 52.—ANATOMY OF THE POSTERIOR TIBIAL AND PERONEAL ARTERIES.

Operation.

The leg being flexed and turned well on its outer side, the operator, who stands on the inner or outer side of the limb, makes a curved incision about 2 inches long, ¾ inch behind and below the inner malleolus. The internal annular ligament is carefully divided. The artery is seen, and the aneurism needle is passed from without inwards.

Memoranda.

I. Do not cut beyond the internal annular ligament, as the artery is just under it.

II. The nerve is on the outer side, next to the veins.

Ligature of the Posterior Tibial Artery in the Upper Part of the Leg.

ANATOMY (Fig. 52).

Superficial.

Skin, fascia, etc.
Gastrocnemius and soleus muscles.
Fascia binding down deep muscles of leg.

Outer Side.		*Inner Side.*
Posterior tibial nerve (below).	**[Artery.]**	Posterior tibial nerve (above).

Beneath.

Flexor longus digitorum.
Tibialis posticus.

Operation.

The leg is flexed and turned well on its outer side. The operator stands on the outer side of the limb. An incision from 4 to 5 inches long is made parallel to the inner border of the tibia and ½ inch behind the bone. The skin is divided. The deep fascia is freely opened up, and the inner edge of the gastrocnemius defined and drawn backwards. The soleus muscle is then seen and divided about ½ inch from its attachment to the edge of the tibia. When this is completed the intermuscular septum or special fascia covering the deep flexor is exposed, and this is opened up. The parts being carefully retracted, the vessel may be found surrounded with fat. The nerve is often exposed before the vessel. The needle is passed away from the nerve.

Memoranda.

I. Make the incision long enough.

II. Be cautious when dividing the skin, as the internal saphena vein is just underneath it, and should be avoided.

III. When the soleus is exposed, divide it with the knife held at right angles to the posterior surface of the tibia.

IV. Remember that there is a central membranous tendon to the soleus, which must not be mistaken for the deep special fascia covering the deep flexor.

V. If the soleus be not divided about ½ inch from its attachment to the tibia, there is fear of dividing the flexor longus digitorum, and thus passing through that muscle, and missing the vessels which are above or posterior to the flexor longus digitorum between it and the soleus.

PERONEAL ARTERY.

Anatomy (Fig. 52).

The artery is represented by a line drawn on the inner side of the posterior aspect of the limb along the fibula. In the upper part of its course the artery lies on the tibialis posticus, and then beneath the flexor longus pollicis down the lower part of the limb.

Ligature of the Peroneal Artery.

Operation.

The leg is flexed and turned on its inner side. An incision 3 inches long is made about the middle third of the bone along the posterior border of the fibula. The soleus is freed from the bone, the deep fascia is exposed and opened, and a search for the vessel is made just behind the posterior border of the fibula.

POPLITEAL ARTERY.

The course of the vessel is from the opening in the adductor magnus—that is to say, about the junction of the lower with the middle thirds of the thigh — the lower edge of the popliteus —*i.e.*, about 3 inches below the bend of the knee-joint, on a level with the lower part of the tubercle of the tibia. The course of the vessel may be represented by a line drawn from a point an inch to the inner side of the middle of the thigh. From this point the line is drawn through the centre of the popliteal space to its lower part between the heads of the gastrocnemius muscle.

Ligature of the Popliteal Artery in the Popliteal Space.

ANATOMY (Fig. 53).

In Front.

Posterior ligament of knee-joint.
Popliteus.

Outer Side.		*Inner Side.*
Gastrocnemius plantaris muscles.	**[Artery.]**	Internal popliteal nerve. Popliteal vein.

Behind.

Skin and fascia.
Gastrocnemius.
Short saphenous nerve.

Operation (Fig. 54).

The patient is rolled over as much on to his face as possible, and the limb extended. The surgeon stands on the right-hand side of the patient; an incision 3 inches long is commenced about the centre of the popliteal space, and is carried downwards to the lower part of the upper third of the leg. The skin and fascia are divided, and the heads of the gastrocnemius are exposed and separated from one another. The leg is now flexed; then with the handle of the knife the tissues are separated, the internal popliteal nerve and popliteal vein exposed; beneath these to the outer side of them and deep is the artery. The needle is passed from within outwards.

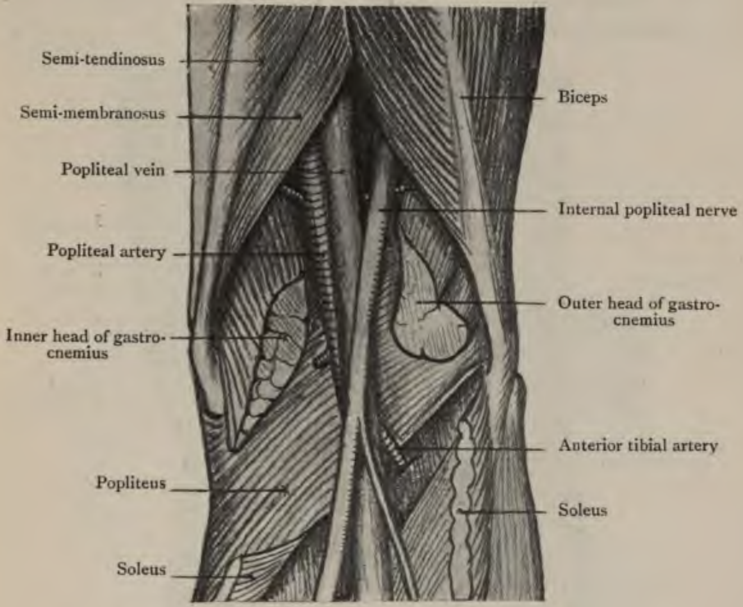

FIG. 53.—ANATOMY OF THE POPLITEAL ARTERY.

Memoranda.

I. Avoid wounding the external saphenous vein and nerve, which are just under the skin and in a line with the vessel.

II. When the heads of the gastrocnemius are exposed, use only the handle of the knife to expose the artery. Unless this is done, some of the small sural arteries may be wounded, or the posterior tibial nerve cut if it is given off higher up than usual, as is sometimes the case.

III. The internal popliteal nerve is superficial to the popliteal vein, and they are both well to the inner side of the popliteal artery, and must be drawn inwards in ligaturing the artery.

Collateral Circulation (*above*).

Superior articular arteries,
Anastomotica magna,
Profunda,
External circumflex
+
Recurrent tibial and inferior articular arteries.

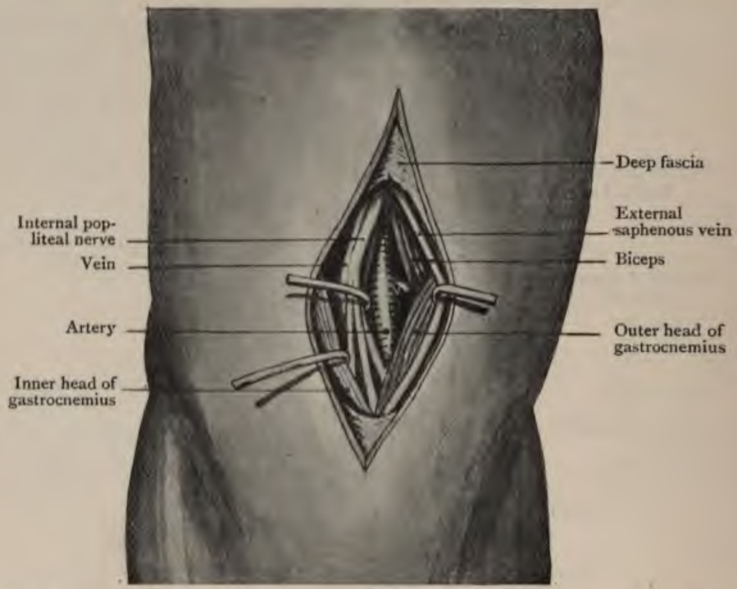

FIG. 54.—LIGATURE OF THE POPLITEAL ARTERY IN ITS POPLITEAL SPACE (RIGHT LEG).

Ligature of the Popliteal Artery in the Thigh.

ANATOMY (Fig. 53).

In Front.
Femur.

Outer Side.
Internal popliteal nerve and popliteal vein.

[Artery.]

Inner Side.
Skin and fascia.
Sartorius.
Internal saphenous vein.

Behind.
Semi-membranosus.

The tendon of the adductor magnus is to be noted on the inner side of the leg.

Operation (Fig. 55).

The surgeon stands on the outer side of the limb to be operated upon. The knee is flexed, and the limb abducted and rotated outwards. The tendon of the adductor magnus is made out, and an incision between 3 to 4 inches long is made just behind and parallel to it in the lower third of the thigh. The skin and fascia are divided; the sartorius muscle comes into view, and must be drawn backwards. The tendon of the adductor magnus is next seen and drawn forwards. The semimembranosus muscle is drawn backwards. Then between these last two structures, embedded in fat, the artery is found. The needle is passed from below upwards.

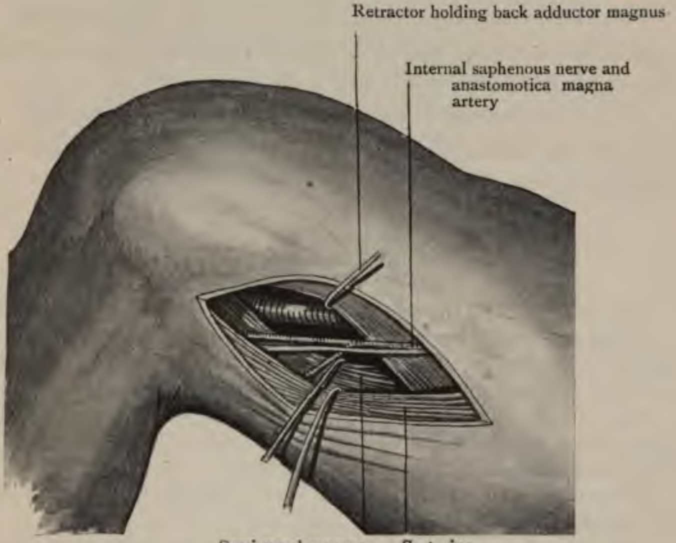
Retractor holding back adductor magnus
Internal saphenous nerve and anastomotica magna artery
Semi-membranosus
Sartorius

FIG. 55.—LIGATURE OF THE POPLITEAL ARTERY IN THE THIGH.

Memoranda.

I. The tendon of the adductor magnus is the guide to the vessel.

II. The sartorius muscle has the internal saphenous vein running on its surface, and care must be taken not to wound it when exposing that muscle.

III. The anastomotica magna may be exposed in the operation wound, must be avoided, and not tied in mistake for the popliteal.

IV. The internal popliteal nerve and popliteal vein are well to the outer side of the vessel, and will probably not be seen.

THE FEMORAL ARTERY.

The line of the artery is from a point midway between the anterior superior spine of the ilium and the symphysis pubis to the tubercle for the adductor magnus on the upper and inner side of the internal condyle of the femur.

The femoral artery is indicated by the upper two-thirds of this line; *i.e.*, it extends from Poupart's ligament to the junction of the middle and lower thirds of the thigh.

The common femoral is represented by the upper 2 inches of the line of the vessel.

The superficial femoral may be divided into two portions: One extends from the end of the common femoral to the apex of Scarpa's triangle—that is to say, it occupies about the upper third of the thigh; the other portion of the femoral in Hunter's canal is represented by about the middle third of the thigh.

Ligature of the Femoral Artery in Hunter's Canal.

Anatomy (Fig. 56).

Hunter's canal occupies the middle third of the thigh. It is bounded outside by the vastus internus, inside by the adductor muscles, and is covered in by strong fascia, which bind these muscles together.

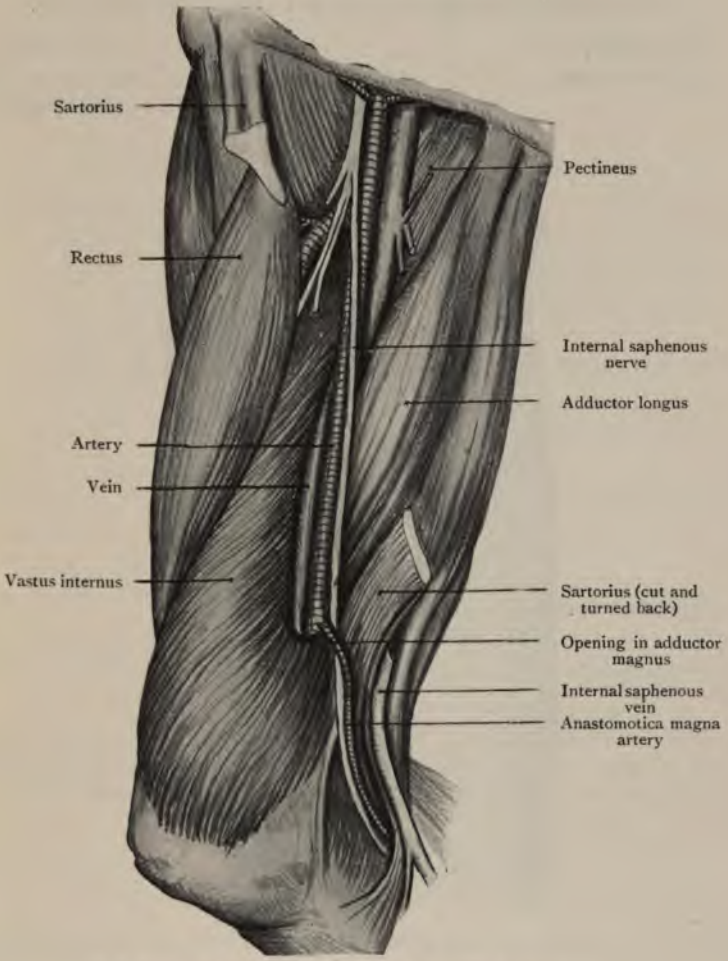

FIG. 56.—ANATOMY OF THE FEMORAL ARTERY.

In Front.
Skin, fascia, and sartorius.
Aponeurosis between the vastus internus and adductors.

Outer Side.
Vastus internus.

[Artery.]

Inner Side.
Adductor magnus
and longus.

Behind.
Femoral vein.

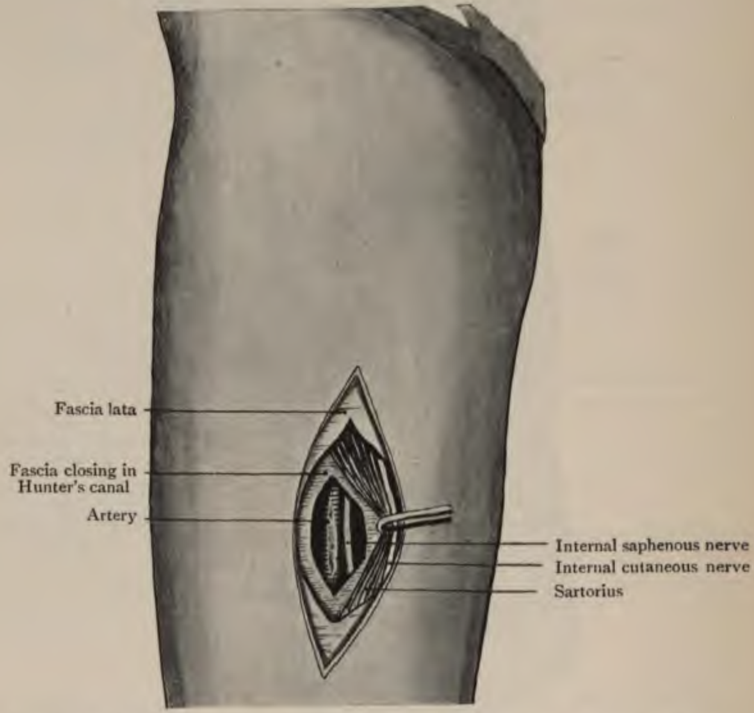

FIG. 57.—LIGATURE OF THE RIGHT FEMORAL ARTERY IN HUNTER'S CANAL.

Operation (Fig. 57).

The operator stands on the inner side of the limb, and the position of the leg is as before. An incision about 4 inches long is made at the centre of the middle third of the thigh and in the line of the artery. The skin and fascia are divided.

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This is of much
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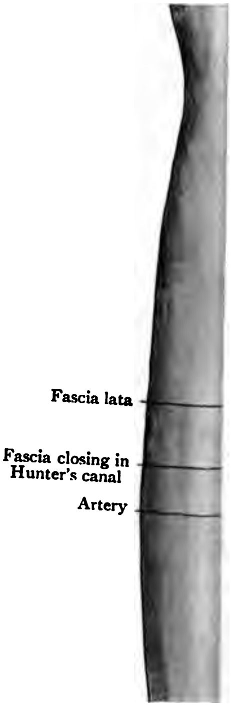
e triangle.
:in is often posterior,

Inner Side.
Femoral vein
(above).

Aponeurosis be

Outer Side.
Vastus internus.



G. 57.—LIGATURE OF

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e sartorius muscle is seen and drawn inwards. The fascia ween the vastus internus and adductors is exposed and ened. The vessel is then found with the internal and henous nerves running across it; these are retracted and vessel ligatured.

Memoranda.

[. It is imperative to keep in the line of the artery and ctly in the middle third of the thigh. This is of much portance, for it is a common mistake to make the incision far outwards, and, again, too low down the thigh, so that the ssel is attacked below the opening in the adductor magnus ıen it has become the popliteal.

II. Exercise every care to find the sartorius, which is well the inner side of the leg, and may be recognised by its res running downwards and inwards, whereas the vastus ernus fibres run downwards and outwards.

III. Avoid the veins and the internal saphenous nerve, ıich are in close relation with the vessel.

gature of the Superficial Femoral Artery at the Apex of Scarpa's Triangle.

Anatomy (Fig. 56).

Scarpa's triangle is formed above by Poupart's ligament, on the ter side by the sartorius muscle, and on the inner side by the ductor longus. These meet at the junction of the upper and iddle thirds of the thigh to form the apex of the triangle.

At the apex of Scarpa's triangle the femoral vein is often posterior, d even rather external, to the artery.

In Front.
Skin, fascia and sartorius.

Outer Side.
ıterior crural nerve
and branches.

[Artery.]

Inner Side.
Femoral vein
(above).

Behind.
Pectineus.
Adductor longus.
Femoral vein (sometimes).

Operation (Fig. 58).

The patient and operator are in the same positions as in the previous operations. An incision 4 inches long is commenced about 1½ inches below Poupart's ligament, so that the centre of the incision is over the apex of Scarpa's triangle. The skin and fascia are divided, and the deep fascia exposed and opened carefully. The inner margin of the sartorius is seen, and the muscle drawn outwards. The sheath of the vessel is then exposed, opened, and the vessel separated with the end of a director. The operator must separate the sheath thoroughly all round. After this is done the aneurism needle is passed from within outwards.

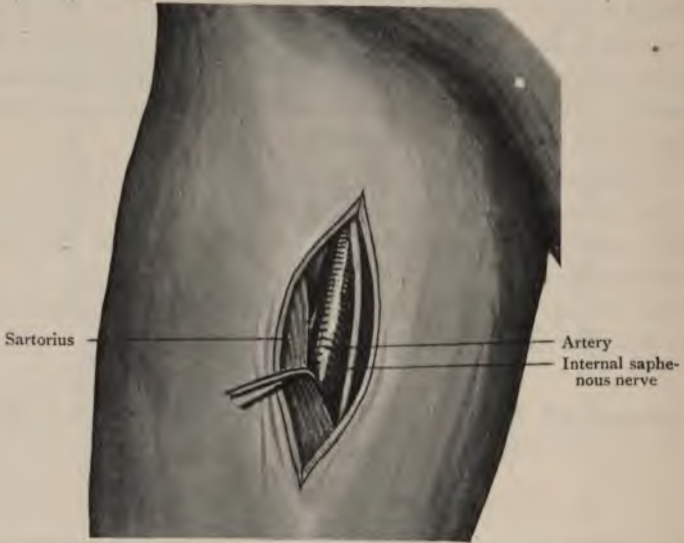

FIG. 58.—LIGATURE OF RIGHT FEMORAL ARTERY AT THE APEX OF SCARPA'S TRIANGLE.

Memoranda.

I. Do not wound the internal saphenous vein, which is quite superficial, and should be to the inner side of the skin incision, but is sometimes just under it.

II. The sartorius is always to be known from other muscles in its neighbourhood by its fibres running downwards and inwards.

III. Avoid all nerves over or on the sides of the vessel.

IV. Remember that at the apex of Scarpa's triangle the femoral vein is often behind the artery, and is separated from the artery by scarcely any definite sheath, so that great care must be taken in freeing the femoral or passing the needle, lest the vein be punctured.

Collateral Circulation.

External circumflex and perforating branches + Branches of popliteal and anterior tibial recurrent.
Comes nervi ischiadici + Perforating and popliteal branches.

Ligature of the Common Femoral Artery.

ANATOMY (Fig. 56).

In Front.

Skin and fascia lata.
Crural branch of genito-crural nerve.

Outer Side.
Anterior crural nerve.

[Artery.]

Inner Side.
Femoral vein (above).

Behind.
Psoas muscle.

Operation (Fig. 59).

The patient lies on his back, and the surgeon stands on the outer side of the limb to be operated upon. The leg is abducted and rotated outwards. An incision about 2½ inches in length is made in the line of the vessel, commencing just above Poupart's ligament. The fascia having been divided and the lymphatic glands turned aside, the fascia lata is opened and the vessel exposed and cleared; the aneurism needle is passed from within outwards.

Memoranda.

I. In consequence of the close proximity of the femoral vein and crural nerves, care must be taken to avoid wounding them or including them in the ligature.

II. Do not wound any superficial veins or arteries in exposing the vessel, as they are needed in the collateral circulation.

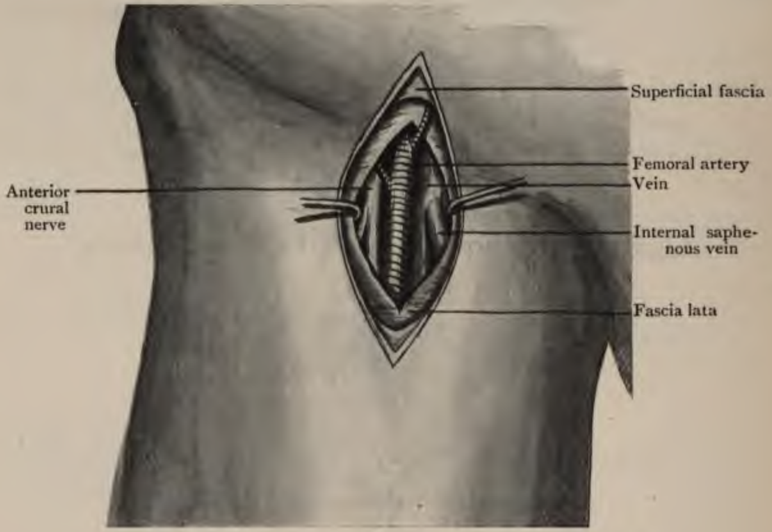

FIG. 59.—LIGATURE OF THE COMMON FEMORAL ARTERY.

Collateral Circulation.

Superficial circumflex iliac + External circumflex.
Gluteal and sciatic + Circumflex and superior perforating.
Comes nervi ischiadici + Articular of popliteal.
Obturator + Internal circumflex.

CHAPTER II

NERVES OF THE LOWER EXTREMITY

THE GREAT SCIATIC NERVE.

IN the thigh the nerve extends from the lower border of the pyriformis to a point a little above the knee-joint, where it divides into internal and external popliteal.

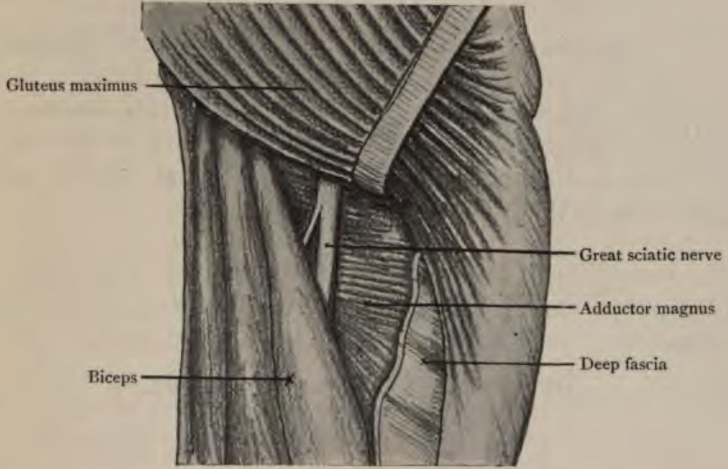

FIG. 60.—ANATOMY OF THE RIGHT GREAT SCIATIC NERVE AT THE LOWER BORDER OF THE GLUTEUS MAXIMUS.

Anatomy (Fig. 60).

It lies between the great trochanter and the tuber ischii. It is covered by the gluteus maximus.

Operation.

The patient is placed in the prone position. A vertical incision, at least 4 inches long, is made, beginning midway between the tuber ischii and the great trochanter, and over the gluteal fold. The skin and fascia are divided and the superficial vessels pulled aside. The lower edge of the gluteus maximus is exposed and drawn upwards. The hamstring muscles are next seen, and drawn inwards. Finally, the nerve is discovered and dealt with.

EXTERNAL POPLITEAL NERVE.

Anatomy.

The biceps tendon is the guide to the nerve.

Operation

The patient is prone. The biceps tendon is found by extending the leg, and an incision about 3 inches long is made parallel to and over the posterior surface of this tendon, the centre of the incision being just above the head of the fibula. The fascia is divided, the biceps tendon exposed, and the nerve found close to the head of the fibula.

Memorandum.

Do not mistake the ilio-tibial band for the tendon of the biceps.

INTERNAL POPLITEAL NERVE.

Anatomy.

Same as the lower part of the popliteal artery.

Operation.

This nerve is best found by employing the incision for ligature of the lower part of the popliteal artery. It is found between the heads of the gastrocnemei, a little superficial to the popliteal vein and artery.

INTERNAL SAPHENOUS NERVE.

Anatomy (Fig. 56).

The nerve leaves Hunter's canal with the anastomotica magna artery, and becomes superficial by piercing the fascia at the posterior border of the sartorius opposite to the inner tuberosity of the tibia.

Operation.

The nerve is best exposed by an incision 1½ inches in length along the posterior border of the sartorius opposite the head of the tibia.

Memoranda.

I. The internal saphenous vein in this region is just superficial to the nerve, and may be used as a guide to the nerve.

II. Be careful not to mistake the superficial cutaneous nerve for the internal saphenous.

ANTERIOR CRURAL NERVE.

Anatomy.

Same as femoral artery.

Operation.

This nerve is best reached about the upper part of the thigh, between the psoas and iliacus muscle, on the outer side of the femoral artery. In this situation an incision 3 inches long is made, commencing on a level with Poupart's ligament. The fascia is divided, the thigh slightly flexed, and the nerve is easily exposed just outside the femoral artery.

Memorandum.

Commence the incision about ½ inch outside the line for securing the common femoral artery.

CHAPTER III

TENOTOMY

Operations.

1. Subcutaneous method.
2. Open method.

DIVISION OF THE HAMSTRING TENDONS.

Biceps Tendon.

The tendon is divided at the outer side of the popliteal space. The patient should be prone, and the leg extended. The operator, having defined the biceps tendon on the outer side of the popliteal space, introduces a sharp tenotome close to the inner side of the tendon. He then inserts a blunt-pointed knife, and divides the tendon from below upwards—that is to say, from its anterior to its posterior surface.

Memoranda.

I. Be most careful of the external popliteal nerve, which lies to the inner side of the tendon and in close relation to it.

II. It is better to use the open method in dividing this tendon.

The Semi-Membranosus and Semi-Tendinosus Tendons.

These are divided in a similar manner to the above. There are no important structures near them. The semi-membranosus tendon is deeper than that of the semi-tendinosus. They should be divided opposite to the condyles of the femur.

TENDO ACHILLES.

The patient being on his back, the foot is rotated outwards. The assistant keeping the tendon on the stretch, the knife is entered about an inch above the os calcis, on the inner side, and the tendon divided.

TIBIALIS POSTICUS TENDON.

This may be divided above or below the internal annular ligament.

Above the Internal Annular Ligament.—With the foot on its outer side, the tendon is made out by flexing the foot, or by taking a point midway between the anterior and posterior aspects of the leg at a spot about 1½ inches above the inner malleolus.

The left thumb is placed on the spot for division, the sharp tenotome is introduced between the tendon and the tibia; a blunt-pointed knife is next introduced. The sharp edge is turned towards the tendon, which by sawing movements is divided by cutting towards the surface.

Memorandum.

If possible, avoid wounding the posterior tibial artery, which is quite close to the tendon.

Below the Internal Annular Ligament.—Here it is divided over the astragalo-scaphoid joint, a piece of skin over the tendon is pinched up, and the knife passed under it and made to divide the tendon by cutting downwards on to the tubercle of the scaphoid.

TIBIALIS ANTICUS TENDON.

This may be divided in front of the ankle-joint or at its insertion into the cuneiform bone.

At the Front of the Ankle-Joint.—The tendon being made prominent, the thumb is placed on the spot for division.

The knife is entered from the *outer* side of the tendon, between it and the extensor longus pollicis. It is passed under the tendon, and then the sharp edge is turned upwards and the tendon divided.

Division at its Insertion.—The knife is introduced between the skin and the tendon, and the tendon is divided by cutting down on the internal cuneiform bone.

THE PERONEI TENDONS.

These tendons are divided by introducing a knife between them and the fibula, about an inch above the external malleolus, and cutting outwards.

Open Method.

Any of the above tendons may be divided by exposing them through an incision 1 inch to 2 inches long, freeing them from the neighbouring parts and dividing them.

CHAPTER IV

EXCISION OF THE JOINTS OF THE LOWER EXTREMITY

THE operations for excision of the joints of the toes are performed in exactly the same way as in the case of the fingers, and so require no further mention. The reader is referred to Excision of the Joints of the Upper Extremity (p. 32).

THE ANKLE-JOINT.

ANATOMY.

In Front (from within outwards).

Tibialis anticus.
Extensor proprius pollicis.
Anterior tibial vessels.
Anterior tibial nerve.
Extensor longus digitorum.
Peroneus tertius.

Outer Side.		*Inner Side.*
Peroneus longus and brevis.	[Joint.]	Internal ligament.

Behind (from within outwards).

Tibialis posticus.
Flexor longus digitorum.
Posterior tibial vessels.
Posterior tibial nerve.
Flexor longus pollicis and tendo Achilles.

The peroneii tendons are close behind the external malleolus.

Excision of the Ankle-Joint.

Operations.

1. Transverse incision.
2. Two lateral incisions (von Langenbeck).

The transverse incision is the easiest, and perhaps the best, for it can be turned into a Syme's amputation should the bones be too diseased for excision.

1. The Transverse Incision (Fig. 61).—The foot is brought to the end of the operating-table, and rendered bloodless by an Esmarch's bandage. The surgeon stands on the right of the foot to be treated. An incision is made across the foot from the tip of one malleolus to the tip of the other; all the tendons on the front of the joint are divided with one stroke of the knife. The ligaments are divided and the joint opened. The soft parts are cleared off the end of the tibia and fibula, and the lower end of the tibia and the malleoli are removed with the saw. Attention is then turned to the astragalus, and when slightly diseased only the upper articular surface is removed. Any pulpy synovial membrane is cut away with scissors. The cut ends of the tibialis anticus and a few of the extensor tendons should be united with catgut or silk.

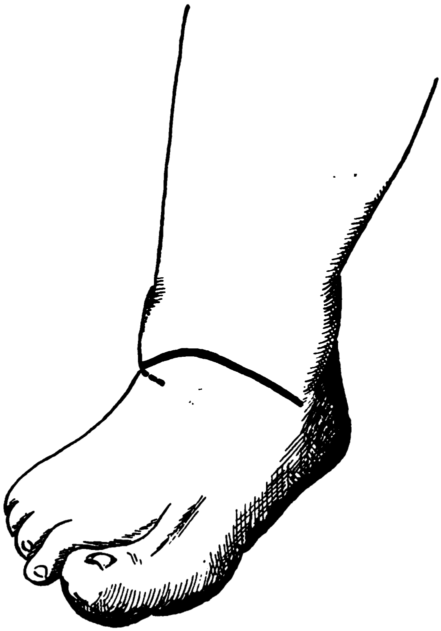

FIG. 61.—TRANSVERSE INCISION FOR EXCISION OF THE ANKLE-JOINT.

Memoranda.

I. Retract the tendons, etc., behind the malleoli, to prevent injury to them while sawing off the lower ends of the bones of the leg.

II. If the periosteum is not diseased, preserve as much of it as possible.

2. Lateral Incisions (Fig. 62).—The foot is put on its side. An incision is made along the posterior margin of the fibula, about 3 inches long, and is then carried along the outer side of the foot nearly to the base of the fifth metatarsal bone. The flap is retracted, and the peronei tendons freed from the fibula. The periosteum, having the ligaments attached, is freed from the lower end of the fibula, and the lower part of that bone removed.

The foot is then turned over, and an incision made along the inner border of the tibia for about 3 inches, and carried along the inner border of the foot to about on a level with the internal cuneiform bone. This flap is reflected, the tibial flexor tendon and the vessels are carefully freed, the periosteum raised from the lower end of the tibia, and the internal malleolus removed. The foot is then forcibly turned outwards, and the lower end of the tibia and the astragalus exposed, and a thin slice sawn off both bones.

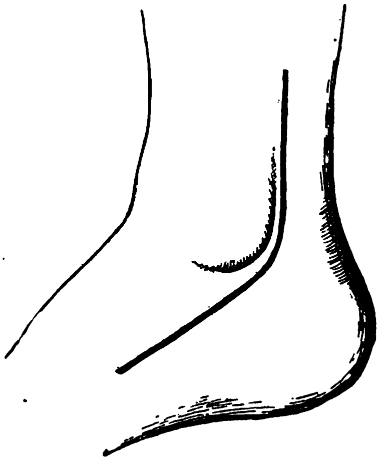

FIG. 62.—INCISION FOR EXCISION OF THE ANKLE-JOINT BY LATERAL INCISIONS.

This figure shows the outer incision; the inner one is similar but shorter.

Memoranda.

I. Make the lateral incisions long enough, so as to have sufficient room.

II. Do not wound the posterior tibial vessels or nerve, or the tendons.

III. If the sheaths of the tendons are not diseased, refrain from opening them.

THE ASTRAGALUS.

Anatomy.

The same as in excision of the ankle-joint. Here, however, note should be taken of the very strong interosseous membrane that is situated on the under surface of the bone and binds it to the os calcis.

Excision of the Astragalus.

Operations.

There are two methods of operating, as in the excision of the ankle-joint. These are:

1. Vertical incision (Vogel).
2. Transverse incision.

1. Vertical Incision.—This is perhaps the better method. A long vertical incision is made, which starts in the leg between the fibula and tibia, rather to the outer part of the anterior surface of the foot and outside the extensor tendons. This is carried downwards to about the line of the calcaneo-cuboid joint, or further if necessary. The wound is well retracted in both directions. The extensor tendons are freed and pulled inwards, the anterior ligament of the ankle-joint is freely divided, and the astragalo-scaphoid joint opened. The head of the astragalus is then seized with lion forceps, and a strong short knife is inserted between the astragalus and os calcis, so as to divide the interosseous ligament; a few further touches of the knife, and the bone is removed.

Memoranda.

I. Make the incision long enough.
II. Avoid wounding any of the tendons or vessels.

2. Transverse Incision.—This consists in an incision carried across the front of the ankle, from one malleolus to the other, dividing all the tendons on the front of the joint; the astragalus is then removed. The tendons that have been divided are united with sutures.

THE OS CALCIS.

Anatomy.

The posterior tibial vessels pass along its inner side, and are continued into the sole to the outer side of the foot at the base of the metatarsal bone of the little toe. The peronei tendons run from behind the external malleolus, and then along the outer side of the os calcis, one above and one below the little tubercle which is to be felt on the outer side of the bone.

The calcaneo-cuboid joint is midway between the external malleolus and the base of the fifth metatarsal bone.

Excision of the Os Calcis.

Methods.

1. Holmes' operation.
2. Treves' operation.

1. Holmes' Operation (Fig. 63).—The foot is placed upon its inner side and made non-vascular by an Esmarch's bandage, an incision is commenced just at the *inner* side of the tendo Achilles, on a level with the upper surface of the os calcis. It is continued across the tendo Achilles, dividing it thoroughly, then around to the outer side of the foot, forwards until it is on a level with the calcaneo-cuboid joint. From this point an incision is made across the sole of the foot towards the inner side of the under surface of the os calcis. The peronei

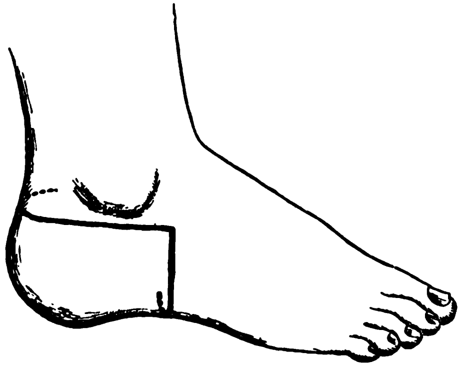

FIG. 63.—HOLMES' OPERATION.

tendons are then pushed upwards with an elevator off the outer side of the os calcis. This plantar flap is well freed and reflected inwards. The calcaneo-cuboid joint is opened, and with a stout knife the interosseous ligament between the bone and the astragalus is divided and the bone removed.

Memoranda.

I. Do not divide the peronei tendons; make the incision along the outer part of the foot, superficial at first, and then push up the tendons off the bone.

II. The transverse incision across the sole must not be carried too far to the inner side of the sole for fear of wounding the plantar artery.

III. When dissecting out the os calcis from its *inner* attachment, be careful to keep the knife close to the bone, for fear of wounding the tendons, vessels, and nerves close to its inner surface.

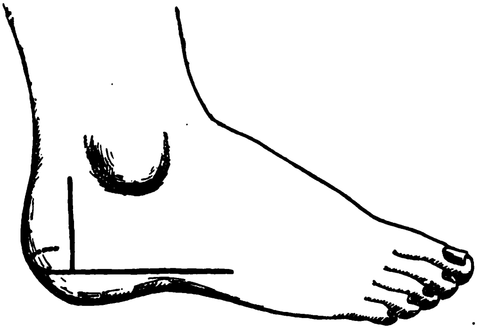

FIG. 64.—TREVES' OPERATION.

2. Treves' Operation (Fig. 64).—The incision is commenced at the base of the fifth metatarsal bone, and is carried horizontally backwards just above the margin of the sole. Then it passes across the back of the heel, and ends about 1 inch to the inner side of the median line behind. A vertical incision about 2 inches long is next made parallel to, and a little in front of, the *outer* side of the tendo Achilles. The flaps so formed are retracted, the peronei tendons freed, and the tendo Achilles divided; the joints are opened and the bone removed.

THE KNEE-JOINT.

Anatomy (Fig. 65).

The popliteal artery runs down the back of the popliteal space, being separated from the knee-joint only by the posterior ligament and some fat.

The lower epiphysis of the femur is on a level with the tubercle for the attachment of the tendon of the adductor magnus.

The tibial upper epiphysis is marked by a transverse line across the head of the tibia, just taking in the facet for the head of the fibula, and on the inner side the depression for the insertion of the semi-membranosus. In front it extends a little lower down, so as to include the tubercle of the tibia.

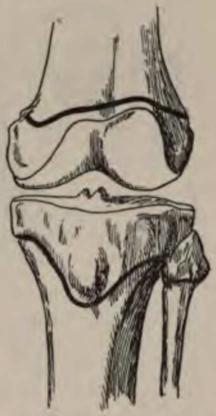

FIG. 65. — DIAGRAM SHOWING THE LINES OF THE EPIPHYSES AT THE KNEE-JOINT.

Excision or Erasion of the Knee-Joint.

Operations.

1. Transverse (through the patella).
2. Semilunar flap (Moreau).
3. Vertical incision (Allingham).

There are many other methods, but the above are the best.

1. Transverse Incision (Fig. 66).—The knee being slightly flexed, an incision is made from the back of one condyle across the patella to the other. The patella is then sawn transversely, and the upper and lower fragments are turned upwards and downwards. The joint is then freely opened by division of the lateral and crucial ligaments. The knee is bent to a right angle, and the condyles of the femur are slightly shifted forwards on the head of the tibia. The condyles are cleared, and the diseased bone is sawn off from before backwards, the direction being at right angles with the long axis of the shaft of the femur.

Next attention is turned to the head of the tibia, and this is shifted forwards so as to overlap slightly the sawn condyles of the femur. It is cleared, and a thin slice is cut off it with the saw from before backwards in a direction at right angles to the shaft of the tibia. Any diseased part of the patella is cut away, and every piece of the diseased synovial tissue removed, great care being taken to clear thoroughly the supra patella synovial pouch.

Finally, the sawn ends of the patella are returned and sutured together by a strong catgut or kangaroo tendon.

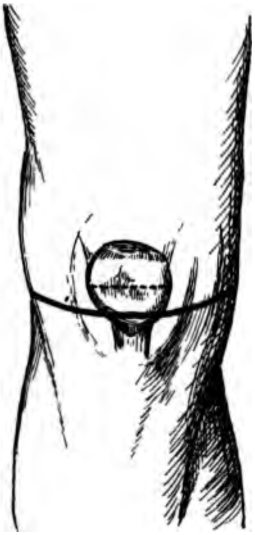

FIG. 66.—EXCISION OF THE KNEE-JOINT BY TRANSVERSE INCISION.

Memoranda.

I. Remember the position of the epiphyseal cartilages, and do not saw through or above them.

II. Do not remove more bone than is absolutely necessary.

III. Remove every piece of diseased synovial membrane.

IV. In making the transverse incision, do not start too far back on the inner side, for fear of dividing the internal saphenous nerve.

V. Be careful not to wound the popliteal artery.

VI. Great care must be taken to saw the bones at right angles to the long axis of the limb.

2. Semilunar Flap (Fig. 67).—In this operation a large U-shaped flap is cut, starting well above one condyle, and extending downwards to the level of the tibial tubercle, and then continued up the other side of the limb to a point opposite to where the incision was started; a flap of skin and cellular tissue is raised. The ligamentum patellæ, with the tubercle attached, is separated from the tibia, the ligament and tubercle being at the completion of the operation wired or pegged to the tibia. The rest of the operation is performed as above described.

In erasion only synovial membrane is removed; if this is not enough to get rid of the diseased tissue it must run on into excision—viz., removal of some of the bones.

Memorandum.

Commence the semilunar flap high enough, so as to fully open up the supra-patella synovial pouch.

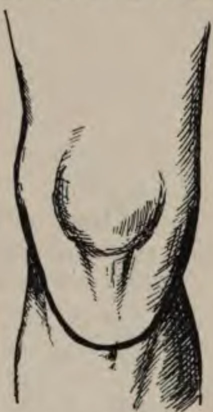

FIG. 67.—EXCISION OF THE KNEE BY SEMILUNAR FLAP.

3. Vertical Incision.—In this operation a vertical incision is commenced about the centre of the anterior aspect of the thigh, 4 inches above the level of the patella, and is carried over the patella down to the tubercle of the tibia. The patella is sawn through in the same line as the skin incision. The two halves of the patella are turned, one outwards, the other inwards, over the condyles of the femur. This is greatly facilitated by freely dividing the tissues above the patella—that is to say, the expansions of the vasti. The rest of the operation is carried out as above described, and at its completion the lateral halves of the patella are united by a couple of catgut sutures passing through the fibrous tissue over each half of the patella. The patella can be scooped out of its fibrous expansion if it is desired. By this mode of operating there is no division of the extensions of the vasti or the ligamentum patellæ to the head of the tibia; hence there is much less weakening of the joint than there is by any other method in which all the fibrous attachments or extensions of the vasti to the tibia are divided.

THE HIP-JOINT.

ANATOMY.

Front.

Psoas.
Iliacus.

Above.		*Inner Side.*
Short tendon of rectus. Gluteus minimus.	[Joint.]	Obturator externus. Pectineus.

Behind.

Pyriformis.
Gemellus superior.
Obturator internus.
Gemellus inferior.
Obturator externus.
Quadratus femoris.

The trochanter major is always prominent, and is on a line with the spine of the pubis; it is about ½ inch lower than the head of the femur. Above the trochanter can be felt the brim of the pelvis, and towards the front part is the anterior superior spine of the ilium.

The tendon of the gluteus maximus overlaps the great trochanter.

Excision of the Hip-Joint.

Operations.

1. Posterior incision.
2. Anterior incision (Barker).

1. Posterior Incision (Fig. 68).—The patient is placed on the sound side, and the surgeon stands on the outer side of the limb. There are many different ways of making the incision for this operation. Perhaps the best is a straight incision, commencing over the middle of the great trochanter, and continued upwards as far as is necessary. This is made to the bone and divides the periosteum. The capsule of the joint is opened. Then with an elevator the muscles attached to the great trochanter are cleared, and the soft parts about the inner side of the neck are freed as much as possible. The soft parts are retracted and the bone is sawn through just below the upper part of the trochanter with a keyhole or Adam's saw. Then, with an elevator or forceps, the head and neck of the bone are elevated out of the acetabulum. This is assisted by division with scissors of any undivided soft parts. The acetabulum is then examined, and any diseased bone is gouged away.

N.B. — In operating on the dead subject, when the joint is normal, considerable difficulty is often experienced in getting out the head; twisting it round with lion forceps will be found the easiest way.

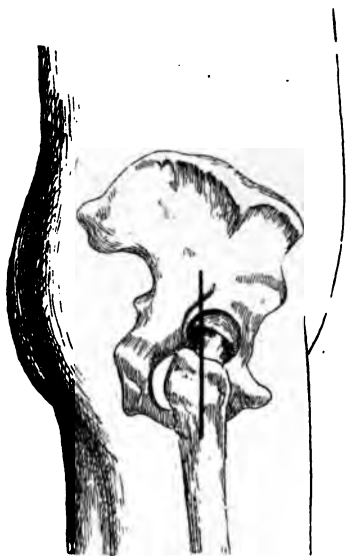

FIG. 68.—EXCISION OF THE HIP-JOINT BY POSTERIOR INCISION.

Memoranda.

I. Make the incision long enough so as not to have to drag on the soft parts too much when extracting the head of the bone.

II. Do not turn the head of the bone out of the wound before dividing it with the saw, lest by using force in so doing the atrophied femur may be fractured lower down.

2. Anterior Incision (Barker) (Fig. 69).—The patient lies on his back, and the operator stands on the outer side of the limb. An incision about 4 inches long is made, beginning ½ inch below the anterior superior spine, and curving slightly downwards and inwards between the tensor vaginæ femoris and the sartorius muscle, and deeper, the glutei outside and the rectus femoris inside. The capsule of the joint is exposed and opened. The wound is held open by retractors.

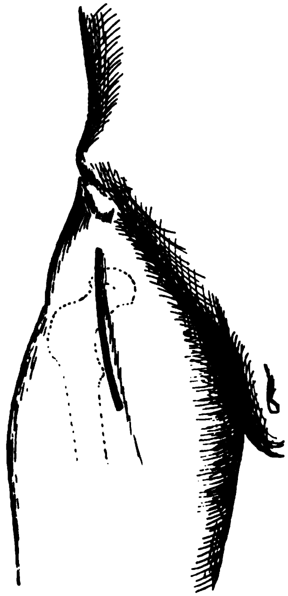

FIG. 69.—EXCISION OF THE HIP-JOINT BY ANTERIOR INCISION.

With the finger on the neck of the bone, it is sawn through with a narrow saw, and then extracted; lastly, the acetabulum is gouged, if there is any diseased bone to remove.

CHAPTER V

AMPUTATIONS OF THE LOWER EXTREMITY

Amputation above the Toes.

Anatomy.

THE metatarso-phalangeal joints are about 1 inch behind the webs of the toes. As in the hand, with the toes flexed the knuckle is represented by the head of the proximal phalanx.

These amputations are performed in exactly the same manner as those already described for the fingers (page 43).

As a rule, choose an operation that admits of the scar not being on the plantar aspect of the foot, since treading on the scar may be painful and cause ulceration.

Amputation at the Metatarso-Phalangeal Joint.

Operation.

The toes may be removed at the joint in exactly the same methods as in the case of the fingers (page 45).

Memorandum.

The position of the joints is far back. Choose an operation in which the resulting scar will not come on the sole of the foot.

Amputation of the Big Toe at the Metatarso-Phalangeal Joint.

Anatomy.

Note the large size of the head of the metatarsal bone. The sesamoid bones are situated under the head and in the tendons of the flexor brevis pollicis.

Operations.

1. Oval method.
2. Internal flap.

The other methods are the same as in the case of the fingers.

1. The Oval Method (Fig. 70) is performed in the following way: The knife is entered in the dorsum of the foot about an inch above the metatarso-phalangeal joint. The incision is extended down the centre of the bone to about the middle of the first phalanx, and is then carried round the toe to join the vertical incision again; the flaps are dissected off the bone. The joint is then opened, and the toe is removed.

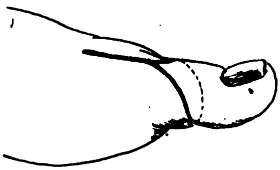

FIG. 70.—OVAL METHOD.

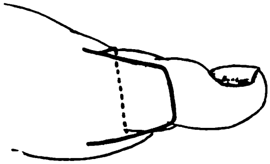

FIG. 71.—INTERNAL FLAP.

2. Internal Flap (Fig. 71).—In this operation the incision for the inner flap is commenced about the metatarso-phalangeal joint, at the junction of the dorsal and internal surfaces of the toe. It is continued down to the last joint, and is then curved downwards over the inner edge of the toe to the plantar surface and back again to a point on a level with that where it started; a short external flap is then cut.

Memoranda.

I. The large head of the metatarsal bone necessitates insuring that the flaps are large enough.

II. Do not remove the sesamoid bones.

III. Whenever possible, leave the base of the first phalanx, as it has many of the muscles of the sole inserted into it, and when it can be left it strengthens the sole of the foot.

Amputation of the Great Toe with the Metatarsal Bone.

Operation.

This operation is exactly similar to the oval method for removing the big toe, except that the incision on the dorsum is commenced at the base of the metatarsal bone.

THE FOOT.

Anatomy (Fig. 72).

The joint between the first metatarsal bone and the internal cuneiform bone can at times be felt. If not, it can be found by measuring 1½ inches below the tubercle of the scaphoid, which is always easily to be made out on the inner side of the foot. The interval between the fifth metatarsal joint and the cuboid is indicated by the prominent base of the fifth metatarsal bone, the joint being just behind it. Should the prominence not be felt, it may be known by its being about an inch in front of the tubercle on the scaphoid. It is well to remember that the base of the second metatarsal bone is dovetailed, between the internal and external cuneiform bones—in other words, is articulating with the middle cuneiform bone, which is shorter than the internal and external cuneiform bones. Hence the second metatarsal bone is wedged between them.

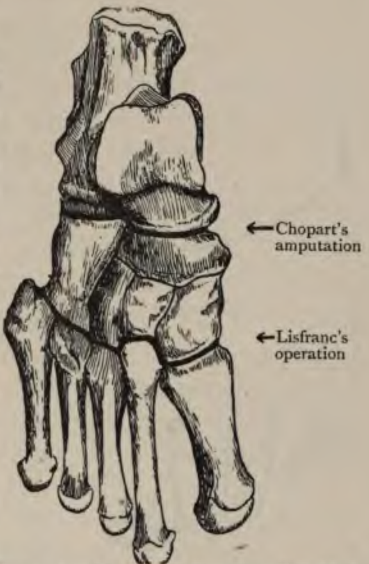

FIG. 72.—DIAGRAM OF THE BONES OF THE FOOT TO SHOW THE LINES OF SEPARATION OF THE TARSUS AND METATARSUS IN CHOPART'S AND LISFRANC'S OPERATIONS.

Running across the plantar surface of the foot, at the junction of the metatarso-phalangeal joints, is a well-marked line. This represents the proximal ends of the base of the back of the toes.

Amputation of the Foot at the Tarso-Metatarsal Joint.

Operations.

1. Lisfranc's.
2. Hey's.
3. Skeg's.

1. Lisfranc's Operation (Fig. 73).—The surgeon stands on the right side of the foot to be amputated. With the first finger and thumb of the left hand, he marks out the base of the fifth and first metatarsal bones. The knife is drawn across the dorsum of the foot from one point to the other, the flap so made being convex downwards; it is slightly dissected up, and the tendons are divided. This being completed, the foot is flexed, and attention is turned to the sole of the foot. The plantar flap is commenced by entering the knife at one of the extremities of the dorsal flap, and continued along the side of the foot until the base of the ball of the toes is reached—that is to say, the metatarso-phalangeal joint. From this point the knife is brought across the sole to the other side of the foot, and is then carried along the side of the foot up to the angle of the base of the dorsal flap. This flap is carefully dissected up as thickly as possible, the knife being kept close to the bones. Attention is next turned to the division of the foot. The anterior part of the foot is strongly depressed, and the knife is entered just above the base of the fifth metatarsal bone, dividing the joints between the three outer meta-

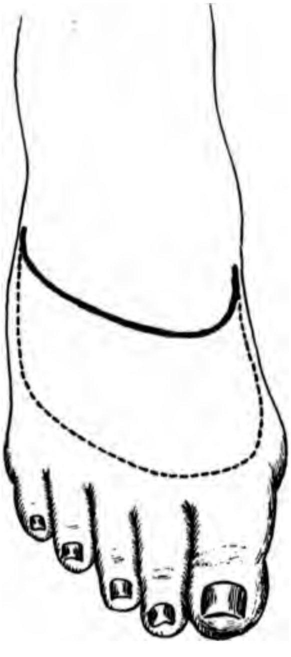

FIG. 73.—LISFRANC'S AMPUTATION.

tarsal bones and the tarsus. Then in like manner the joint between the first metatarsal bone and the internal cuneiform bone is opened. Lastly, the knife being held in dagger fashion, the point is entered between the base of the first and second metatarsal bones, and forced upwards.

In a similar manner the knife should be inserted between the second and third metatarsal bones.

This frees the second metatarsal bone from its wedge-like position. The foot is then removed with a few touches of the knife.

Arteries requiring attention are: The dorsalis pedis, the two plantar arteries, and some of the digital vessels.

Memoranda.

I. Remember to cut the plantar flap a little longer on the inner than on the outer aspect of the foot, so as to be able to cover the bones, which project more on the inner than on the outer side.

II. The dorsal flap should be commenced well on the outer or inner side of the foot, and be extended well to the other side. It should not be made too narrow at its base, as is the case if the flap is started and ended absolutely on the dorsum of the foot.

2. Hey's Operation is done in the same manner, the modifications being that Hey divided the fifth, fourth, third, and second joints with the knife, and then sawed off a piece of the internal cuneiform bone.

3. Skeg's Operation.—The special point in this operation is that Skeg disarticulated the three outer joints and the first joint, and sawed through the base of the second metatarsal bone.

Amputation at the Transverse Tarsal Joint.

Anatomy.

The tubercle of the scaphoid, it must be noted, is about 1 inch in front of the internal malleolus. To open the astragalo-scaphoid joint, the knife must be entered just behind the tubercle.

On the outer side of the foot, the interval between the os calcis and the cuboid bone must be borne in mind. This is found at a point midway between the external malleolus and the base of the fifth metatarsal bone.

Operations.

1. Chopart's method.
2. Tripier's method.

1. Chopart's Method (Fig. 74).—The operator stands on the right side of the foot to be removed, and with the thumb and forefinger of the left hand marks out the tubercle of the scaphoid and calcaneo-cuboid joint. The dorsal flap is then cut, commencing well on the side of the foot, and the incision is made across the foot over the bases of the metatarsal bones to the outer or inner border of the foot, as the case may be. This incision is convex downwards, divides everything to the bone, and the flap is dissected up. The foot is then flexed, and at the angles of the base of the dorsal flap an incision is made down the side of the foot to a point on a level with the *base* of the balls of the toes. It is then continued across the sole of the foot to the other side, and back to the base of the dorsal flap. All the structures down to the bones are then dissected up. Attention is now turned to the dorsum, and, with the foot extended, the knife is made to open either the calcaneo-cuboid joint or the astragalo-scaphoid joint first, and is then carried through the foot to the other joint. The cut extensor tendons of the foot should be sutured to the dorsal flap, and, lastly, the upper and lower flaps united.

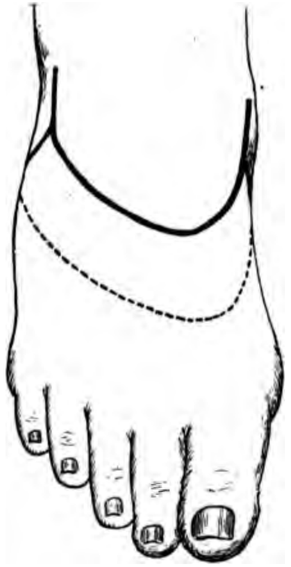

FIG. 74.—CHOPART'S AMPUTATION.

The vessels to be secured are the dorsalis pedis, internal and external plantar arteries, and the digital vessels.

Memoranda.

I. Cut the plantar flap a little longer on the inner part of the base than on the outer, in order to cover the inner aspect of the stump.

II. In disarticulating, use no force with the knife; allow it to find its way into the joints rather than attempt to force it into them.

III. Take care to commence the incision at the posterior part of the tubercle of the scaphoid, otherwise the scaphoid may be left, the joints between that bone and the cuneiforms being opened by mistake.

2. Tripier's Method (Fig. 75) is merely a modification of Chopart's amputation, and consists of a horizontal division of the os calcis on a level with the sustentaculum tali. The dorsal flap commences from the outer part of the tendo Achilles at its insertion, and passes 1½ inches below the external malleolus forwards to a point about 1½ inches above the base of the fifth metatarsal bone. The incision is then continued across the foot to the inner side of the extensor proprius pollicis tendon over the base of the first metatarsal bone. From this point the plantar flap is made by an incision downwards and forwards over the inner part of the sole (an inch from the base of the first metatarsal bone), and then obliquely across the base of the metatarsal bones, and so backwards to join the dorsal incision over the outer part of

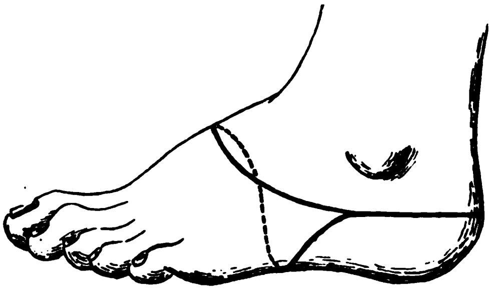

FIG. 75.—TRIPIER'S AMPUTATION.

the os calcis. The flaps are then raised. Disarticulation is done as in Chopart's amputation. The periosteum of the os calcis is raised, and the lower part of the os calcis removed on a level with the sustentaculum by sawing horizontally.

Subastragaloid Amputation.

Anatomy.

The head of the astragalus is easily found, as it is just behind the tubercle of the scaphoid on the inner side of the foot.

Operations.

1. Heel flap (Lignerolle).
2. Maurice Perrin.
3. Farabœuf.

The first mentioned of these is the simplest, and is performed in very much the same manner as Syme's amputation, presently to be described.

1. Heel Flap (Fig. 76).—An incision is commenced about ½ inch below and in front of the external malleolus, and is carried under the foot to the inner side about 1 inch below the inner malleolus. All the tissues are divided to the bone. The dorsal flap is then formed, and should be both long and **U**-shaped, commencing at the extremities of the base of the plantar flap and extending down to the level of the astragalo-scaphoid joint. The plantar and dorsal flaps are then dissected back, taking up all tissues to the bones.

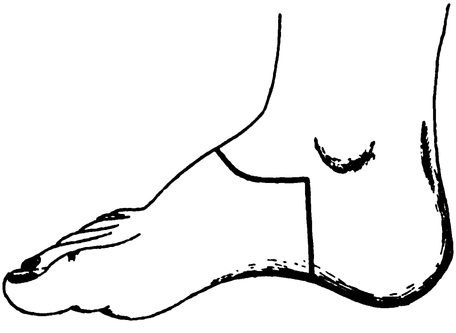

FIG. 76.—HEEL FLAP AMPUTATION.

The astragalo-scaphoid joint is opened, and the knife carried backwards into the calcaneo-astragaloid joint. The interosseous ligament is divided and the foot removed.

Memoranda.

I. Cut the dorsal and plantar flaps sufficiently long.

II. Keep the knife as close to the bone as possible in dissecting out the os calcis from the heel flap.

2. Perrin's Operation (Fig. 77).—The incision is commenced from the tendo Achilles about an inch below the tip of the external malleolus. This is carried straight forwards to the base of the metatarsal bone of the little toe. It is then continued across the dorsum of the foot to the base of the metatarsal bone of the big toe, and thence obliquely backwards and outwards across the sole of the foot and round the outer border of the foot to join the first horizontal part of the incision at the calcaneo-cuboid joint. The soft parts about the outer side of the os calcis are separated, and the dorsal flap is dissected back to the head of the astragalus. The interosseous ligament can then be easily reached by depressing the toes. The knife is passed between the astragalus and the scaphoid, and then backwards and inwards along the under surface of the astragalus, separating it from the os calcis. Lastly, the soft parts of the inner side of the foot are freed from the os calcis.

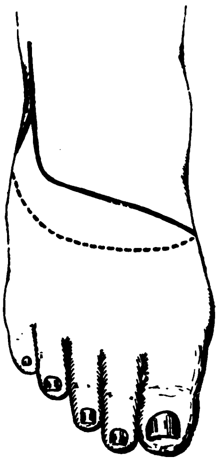

FIG. 77. — PERRIN'S OPERATION.

3. Farabœuf's Subastragaloid Amputation.—With the foot projecting over the end of the table, an incision is commenced about a finger's breadth below the tip of the external malleolus; from this point it is carried forwards parallel with the outer edge of the foot to a point on a level with the base of the fifth metatarsal bone. It is then continued across the dorsum of the foot, passing just in front of the articulation between the scaphoid and cuneiform bones as far as the tendon of the proprius hallucis; from here it is carried round the inner border of the foot across the sole, back to the outer border of the foot, and backwards along this border until it reaches the back of the heel, then upwards for about an inch, and finally forwards again to the point at which it started. The incision is carried down to the bone throughout, and the flap dissected up. The joint between the astragalus and the scaphoid is opened; then, by depressing the foot the strong ligament between the astragalus and os calcis can be divided. The tendo Achilles is next divided at its insertion, and the soft structures dissected off the os calcis. When the edges of the flap are brought together, the line of the incision should be on the external and anterior aspects of the stump.

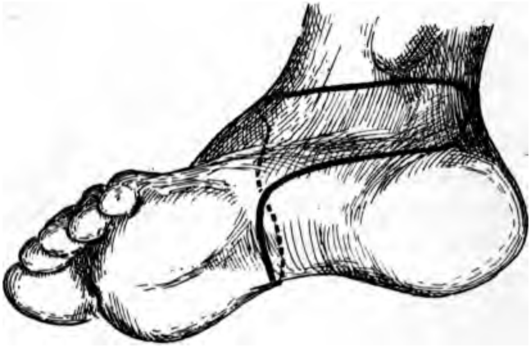

FIG. 78.—FARABŒUF'S SUBASTRAGALOID AMPUTATION.

THE ANKLE-JOINT.

Anatomy.

Note the positions of the external and internal malleoli. The external one projects lower than the internal, and is at the same time posterior to it.

The line of the ankle-joint—that is to say, the interval between the bones of the leg and the astragalus—lies about ½ inch above the tip of the internal malleolus.

The internal calcaneal artery, which chiefly supplies the heel flap, arises from the external plantar artery under the fibres of the abductor pollicis. This is very close to the line of incision.

Amputation of the Foot at the Ankle-Joint.

Operations.

1. Long posterior flap (Syme).
2. Internal lateral flap (Roux).

1. Syme's Amputation (Fig. 79).—The foot being held at right angles to the leg, an incision is commenced at the tip of the external malleolus, and is continued straight across the sole to a point half an inch below the tip of the internal malleolus. This incision is made straight down to the bone. The foot is then extended, and a dorsal incision, slightly convex downwards, is drawn straight across the foot from one extremity of the plantar flap to the other. In this cut the tendons are divided and the ankle-joint opened. The lateral ligaments are then divided. After this, keeping close to the upper surface of the os calcis, the tendo Achilles is divided; the soft parts are separated from around the posterior part of the heel and from its sides. With a few strokes of the knife the foot is removed. Next the soft parts over and on the sides of the malleoli are freed, and the malleoli sawn off, and with them a thin slice of the lower end of the tibia.

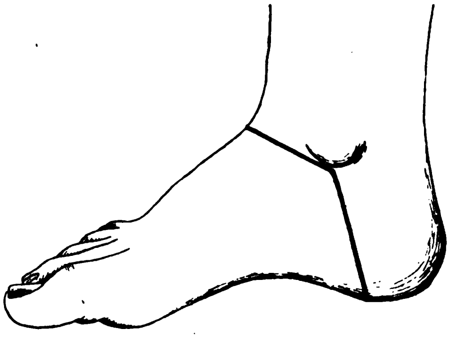

FIG. 79.—SYME'S AMPUTATION.

Arteries divided are the anterior tibial, external and internal plantar.

Memoranda.

I. Commence the plantar incision rather to the posterior part of the apex of the external malleolus, and end it ½ inch below the internal malleolus. Do not continue the incision up to the internal malleolus, or posterior to it, for if this is done the posterior tibial artery will be severed before it divides into the plantar arteries.

II. Incline the plantar incision more to the back of the heel than forwards; otherwise the flap will be too large, and may slough.

III. Do not make a long dorsal flap, as the scar will then come on the end of the stump.

IV. In dissecting out the os calcis, keep quite close to the bone for fear of buttonholing the flap or scoring the arteries in it.

V. Where it is possible, leave the periosteum at the back of the heel attached to the flap.

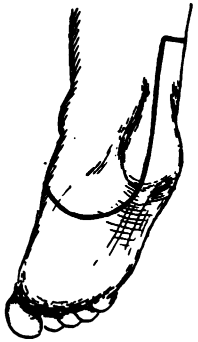

FIG. 80.—INTERNAL LATERAL FLAP (ROUX).

2. Internal Lateral Flap (Roux) (Fig. 80).—The incision is begun at the apex of the external malleolus, and carried half across the front of the ankle-joint. Thence it is continued in an oblique direction inwards over the astragalo-scaphoid joint, round the inner side of the foot to the centre of the sole, and after that vertically backwards along the middle line of the under surface of the heel, and finally ascends the posterior aspect of the heel and ends at the apex of the external malleolus, the point at which it had begun. The ankle-joint is opened at the upper and outer part, and the soft parts separated from the os calcis. Lastly, the malleoli and the end of the tibia are removed.

Amputation of the Foot by Pirogoff's Method.

This is performed in exactly the same manner as is Syme's method, excepting that the posterior part of the os calcis is retained and fixed up to the end of the tibia. An incision is made from one malleolus to the other across the sole of the foot. Into this wound the saw is introduced, and the posterior part of the os calcis is sawn off behind the astragalus, the direction of the division being upwards and slightly backwards. The heel flap is raised, and is separated upwards behind the ankle-joint. The dorsal incision is then made as in Syme's operation. The soft parts in front are retracted, the lower ends of the bones of the legs are cleared, and the articular surface and the malleoli are sawn off. The sawn end of the os calcis is then turned up so as to be in contact with the sawn end of the tibia.

THE LEG.

Anatomy.

The fibula is situated rather to the posterior part of the leg compared with the tibia. Note the large mass of muscles on the posterior aspect of the leg as compared with the anterior muscles.

In the leg many modes of operation may be employed. They are enumerated and classified according to their respective merits in the various regions, viz.: Lower third, middle third, and upper third.

In these operations the surgeon should stand on the right side of the limb to be removed, the patient's leg being brought over the end of the table. The leg is held extended.

Amputations of the Leg in the Lower Third.

Operations.

The following are best suited to the lower third of the leg.

1. Long anterior flap.
2. Circular method.
3. Elliptical posterior flap (Guyon).

1. The Anterior Flap Operation (Fig. 81) is perhaps best in this region. An anterior flap is cut, being equal in length to the diameter of the leg at the base of the flap. It is marked out by an incision, beginning at the internal edge of the tibia on the inner side, a little below the point at which the bones are to be divided, and ending at a point directly opposite over the fibula. The anterior muscles are divided transversely ½ inch above the lower end of the flap, and are dissected off the bones and interosseous membrane as high as the base of the flap. The posterior flap is next cut by transfixion, and the bones divided. Arteries which need securing are the anterior and posterior, tibial and peroneal.

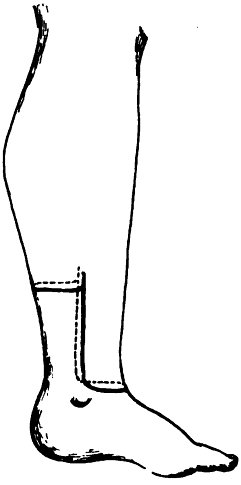

FIG. 81.—THE ANTERIOR FLAP OPERATION.

Memoranda.

(These apply to all amputations of the leg.)

I. Cut the flaps long enough, as in this region the parts retract a great deal. Be careful to keep the flaps as broad at the end as at the base.

II. Seeing that many of these operations include muscles, take care to keep close to the interosseous membrane. Do not use the knife, but separate the muscles from the membrane by the finger or handle of the knife, for fear of wounding the anterior tibial artery.

III. Remember that the fibula is on a plane a little posterior to the tibia, and that it should be sawn through before the tibia, or at the same time.

2. Circular Method.—A circular incision is made round the leg dividing the skin. This is dissected up, and the muscles by a circular incision are divided down to the bone. These are then retracted, and the bones are sawn through a little higher up.

3. Elliptical Posterior Flap (Guyon's) (Fig. 82).—In this operation the incision is commenced in front of the ankle and sweeps across it. It extends along the inner side of the foot, just missing the internal malleolus, and on the outer side it passes immediately in front of the external malleolus. These incisions meet at a point directly behind and over the heel. This flap is dissected up, the tendo Achilles is separated from the os calcis, and the flap is freed to about 2 inches above the malleoli. Then the lower ends of the bones of the leg are sawn through.

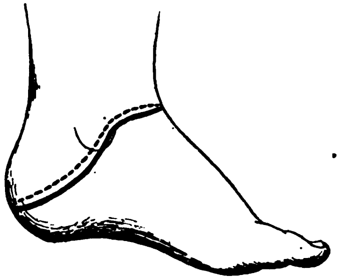

FIG. 82.—ELLIPTICAL POSTERIOR FLAP (GUYON).

Amputations of the Leg in the Middle Third.

Operations.

The following are best suited to the middle third of the leg:

1. Long anterior rectangular flap (Teale's).
2. Long posterior rectangular flap (Lee's).
3. Simple anterior and posterior skin flaps.

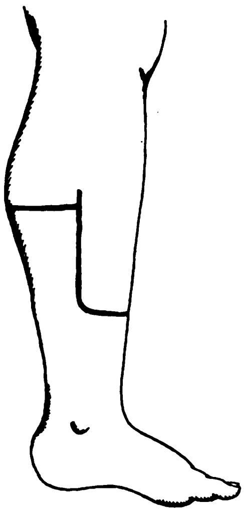

FIG. 83.—LONG ANTERIOR RECTANGULAR FLAP (TEALE'S).

1. Long Anterior Rectangular Flap (Teale) (Fig. 83).—On each side of the leg vertical incisions are made equal in length to half the circumference of the leg at the point of division of the bones. These incisions must be vertical and exactly parallel (one along the fibula, and the other along the inner border of the tibia), so that the end of the flap may be as broad as the base. The lower extremities of these incisions are then joined by a transverse cut. This flap is dissected up, and must contain all the muscles on the front of the leg down to the interosseous membrane. The posterior flap, which is one-fourth the length of the anterior flap, is made by a transverse cut across the back of the limb straight down to the bones, and is dissected up to the base. The bones are then cleared and sawn through. (See Memoranda on page 122.)

2. Long Posterior Rectangular Flap.—This operation is performed in the same manner as Teale's method, except that, as the name indicates, the long flap is posterior.

3. Anterior and Posterior Skin Flaps.—These flaps are cut convex at their ends, and the muscles are divided by a circular incision just below the division of the bones. (See similar operation on forearm, p. 53.)

Amputations of the Leg in the Upper Third.

Operations.

The following are best suited to the upper third of the leg:

1. External flap (Farabœuf).
2. Circular method.
3. Equal lateral flaps.

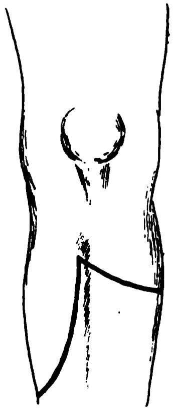

FIG. 84.—FARABŒUF'S AMPUTATION.

1. External Flap (Farabœuf) (Fig. 84).—In this operation a large external flap is made, equal in length to half the circumference of the limb at the point of division of the bones. The incision commences at a point a finger's breadth external to the crest of the tibia, and ends at a point on the posterior aspect of the leg, an inch higher than that at which it started. The large flap with all the muscles attached is dissected up to the bone. A small skin flap, slightly convex, is then made from the inner and anterior sides of the leg, joining the base of the external flap. This small flap is dissected up, the remaining muscles are then divided transversely, the bones sawn through, and the prominent edge of the crest of the tibia is removed. (See Fig. 85; Memoranda, see p. 20.)

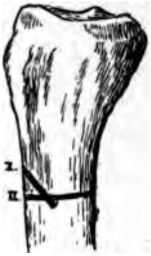

FIG. 85. — DIAGRAM TO SHOW METHOD OF SAWING THE BONE.

In the diagram, Cut I. should be made first and then Cut II.; this prevents a sharp edge being left in front.

2. Circular Method.—A circular skin incision is made at a distance below the saw-line equal to half the circumference of the limb at that point. The cut is carried all round the limb, but the posterior part of the circular incision should be about an inch above the anterior cut. This sleeve is dissected up to a point on a level with the place where the bones are to be divided; the muscles are divided just below the base of the flap, and the bones are sawn through, a small piece being removed from the prominent anterior edge of the tibia, so as to rid it of the sharp point.

3. Equal Lateral Flaps (Fig. 86).—In this operation the flaps are made convex at their extremities. The incision is commenced about 1 inch below the saw-line, at the anterior edge of the limb, just to the outer side of the crest of the tibia, and carried round the back of the leg, to a point directly opposite the starting-point. These flaps, which are equal to half the diameter of the leg, are dissected up, the muscles severed by a circular cut and the bones divided.

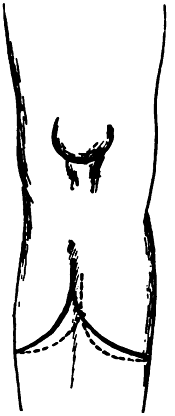

FIG. 86. — EQUAL LATERAL FLAPS.

KNEE-JOINT.

Anatomy.

The internal condyle of the femur is more prominent and larger than the external one, and extends rather lower down. The external and internal heads of the tibia can be felt distinctly, and just above, between them and the condyles of the femur, are the two semilunar cartilages. The head of the fibula is on a line with the tubercle of the tibia.

Amputation through the Knee-Joint.

Operations.

1. Long anterior and short posterior flaps.
2. Lateral flaps (Stephen Smith).
3. Single anterior long flap.

1. Long Anterior and Short Posterior Flaps (Fig. 8).—The patient is brought to the edge of the operating-table, and the leg slightly flexed. The operator stands on the right side of the limb to be amputated, and places the first finger and thumb of his left hand on the interval between the femur and the tibia, the finger on one side of the joint, the thumb on the other; the knife is entered just below one of the points so marked, and carried down the leg until it reaches a spot about 2 inches below the tubercle of the tibia. The knife is carried squarely across the front of the leg to the other side, and back to the other fixed point. The joint is opened, and the flap is dissected up, including the patella. From the base of this flap a posterior one is cut, which is about two-thirds of the length of the anterior one, and is dissected up in like manner. The flaps are held well back by an assistant, and a circular sweep of the knife across all the remaining soft tissues separates the leg

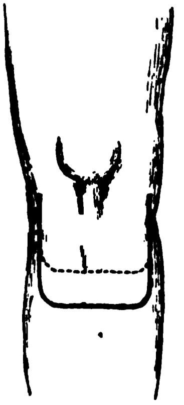

FIG. 87.—LONG ANTERIOR AND SHORT POSTERIOR FLAPS.

from the thigh. It may be advisable to leave the semilunar cartilages on the femur. In this case a little care must be taken in separating them from the head of the tibia.

Memoranda.

I. Cut the flaps long enough.

II. Remember to cut the ends of the flaps quite square.

III. Be careful to include plenty of the cellular tissue in the flaps.

2. Lateral Flaps (Stephen Smith) (Fig. 88).—As in the former operation, the leg is brought over the end of the table. The operator commences the incision about an inch below the tubercle of the tibia, carries it slightly downwards, then around the side of the limb to the back of the joint, and vertically upwards to the centre of the articulation behind.

The knife is entered again at the spot just below the tubercle of the tibia, and carried in like manner round the other side of the joint to meet the incision behind. The flaps are dissected up, the ligamentum patellæ divided, and, the leg being extended, the semilunar cartilages are separated from the head of the tibia. The knife is carried through the joint, and the soft parts behind divided straight outwards.

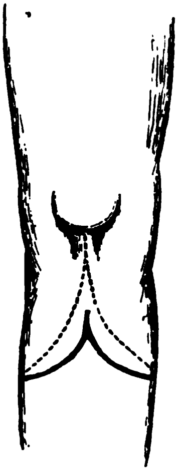

FIG. 88. — STEPHEN SMITH'S AMPUTATION.

Memoranda.

I. Start the incision well below the tubercle of the tibia.

II. The lateral flaps must be well rounded.

III. When the lateral flaps are cut to the posterior aspect of the limb, the posterior edges of the flaps must be made by the one incision running up to the back part of the articulation. If this is not carefully attended to—that is to say, if a **V**-shaped piece of skin is removed with the limb—the flaps will not be broad enough to cover the condyles of the femur.

3. Long Anterior Flap.—This is performed as in the other operations, except that the flap must be made to extend to 2 inches below the tubercle of the tibia, and the posterior flap is cut short. The joint is then opened, and the limb removed.

THE THIGH.

Anatomy.

The tubercle of the adductor magnus is just above the internal condyle.

The muscles are larger and more bulky on the posterior than on the anterior aspect of the limb.

In amputation through the upper part of the thigh, the femoral artery is in the anterior flap.

In amputation in the lower part of the thigh, the femoral artery is in the posterior flap.

The long saphenous nerve is in very close relation with the artery.

Amputations about the Lower Third of the Thigh.

Operations.

1. Carden (anterior flap).
2. Gritti.
3. Stokes' modification of Gritti's.
4. Lateral flaps.

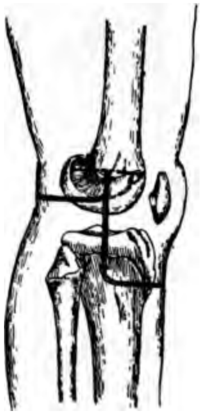

FIG. 89.—CARDEN'S AMPUTATION.

1. Carden's Operation (Fig. 89).—The surgeon stands on the right side of the limb, and with the forefinger and thumb grasps the thigh on a level with the upper border of the patella. The limb is extended, and the point of the knife is entered on one side, and carried downwards to a line on a level with the tubercle of the tibia; the knife is then drawn across the limb to the other side, and up to a point opposite to the commencement of the incision, so marking out the anterior flap.

The knife is next pushed across through the soft tissues at the base of the flap so as to emerge at the opposite angle. The knife is next carried downwards beneath the patella, and through the soft parts to the end of the flap. This is then reflected, and the remaining soft parts about the front of the condyle are divided, and the condyles are sawn through. Lastly, a short posterior flap is cut.

Arteries divided: these are the same as in the amputation through the knee-joint.

Memoranda.

I. Saw the condyles through below the epiphyseal cartilage if it exists, its position being known by the position of the adductor tubercle.

II. Remember to make the anterior flap broad enough and long enough.

2 or 3. Gritti's or Stokes' Amputation (Fig. 90).—The surgeon is in the same position, and the limb is held in the same way as in the former operation. The anterior flap is commenced on the level of the tuberosity of the femoral condyle, and is carried well down the side of the joint to a point level with the tubercle of the tibia, the flap being cut square at its extremity, and the incision carried up the other side of the joint to a spot opposite to where the incision was commenced. The ligamentum patellæ is divided and dissected up with the patella. A small posterior flap is then cut and retracted, the soft parts are all divided to the bone, and the femur sawn through about ½ inch above the tubercle of the adductor magnus—that is to say, just above the condyles. The articular surface is sawn off the patella, and the latter is applied to the cut end of the femur, and fixed there with a suture if necessary.

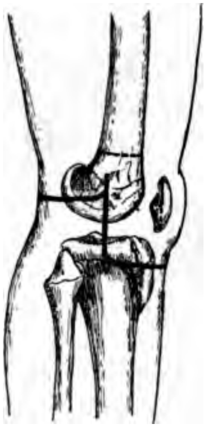

FIG. 90.—GRITTI'S AMPUTATION.

The only difference between Gritti's and Stokes' operation is that, strictly speaking, Gritti saws through the condyles, and Stokes saws through the lower end of the femur. In Stokes' amputation the patella certainly fits better to the femur than it does when the condyles are divided.

4. Lateral Flaps.—These are the same as in the amputation through the knee-joint.

Amputations about the Middle and Upper Parts of the Thigh.

Operations.

The thigh may be amputated by almost any method. The best, however, are:

1. Anterior and posterior skin flaps and circular division of the muscles.
2. Circular amputation.
3. Syme's modification of the circular method.
4. Anterior and posterior flaps by transfixion.

1. Anterior and Posterior Skin Flaps and Circular Division of the Muscles (Fig. 91).—The surgeon stands on the right side of the limb to be removed, the patient is brought to the end of the table, and the other leg held out of the way. With the thumb and fingers of the left hand the thigh is grasped at the position at which the bone is to be divided.

The point of the knife is then entered just below the point of the finger, and carried downwards for about 4 inches (depending on the size of the limb), then straight across the limb, and vertically back to the position where the thumb rests. The flap is dissected up. The limb is raised, and the posterior flap, a little shorter than the anterior one, is in like manner cut and retracted. The muscles are divided with a circular sweep of the knife, all round the limb down to the bone, the periosteum freed, and the bone sawn through. Some surgeons, after cutting the anterior skin flap, prefer to transfix the posterior soft parts and cut out.

The arteries requiring attention in amputations about the upper part of the thigh are: Femoral, some perforating, or profunda, and the external circumflex. In the lower part of the thigh the femoral, popliteal, anastomotica magna, and perforating.

This amputation is best suited for the upper or middle parts of the thigh.

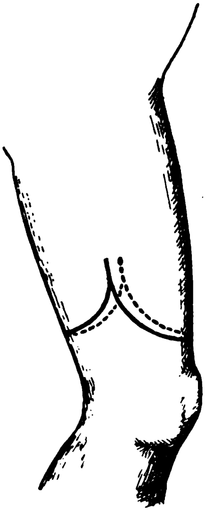

FIG. 91.— ANTERO-POSTERIOR FLAPS.

Memoranda.

I. In stout subjects, have the posterior soft parts raised while fixing the points for starting the anterior flap; otherwise the anterior flap will not be made broad enough.

II. Do not include the long saphenous nerve in the ligature for the femoral artery.

III. When amputating about the middle third of the thigh, if transfixing the posterior flap, care must be taken not to transfix the femoral vessels. They must be avoided so as to remain in the posterior flap.

2. Circular Amputation.—This is performed as has been described in circular amputations elsewhere. The skin, superficial and deep muscles, and bone, are divided in different planes. This method is best suited to amputations about the lower third of the thigh.

3. Syme's Modification of Circular Amputation simply differs in that, when the circular skin cut is made, a small lateral incision is also made on one side of the limb, so as to enable the surgeon more easily to reflect the skin cuff.

Memorandum.

On account of the greater retracting power of the muscles at the posterior aspect of the thigh than at the anterior, the whole circular cut should be made a little oblique from before backwards or from above downwards, so that the circular cut behind is a little lower than on the anterior aspect of the limb.

4. Anterior and Posterior Flaps by Transfixion.— This is done as in amputating in other parts, and therefore need not be here described. It is said to be of advantage when great rapidity is imperative; otherwise it is not so good an amputation as the others.

THE HIP-JOINT.

Anatomy.

The femoral artery is to be found at the centre of a line that extends from the anterior superior spine of the ilium to the centre of the symphysis pubis. The branches of the sciatic and gluteal arteries run down the back of the leg between the great trochanter and tuber ischii. The trochanter major should be noted, and can always be felt just beneath the skin on the outer side of the pelvis. The great trochanter is nearly on a level with the spine of the pubis.

The tuber ischii is to be felt at the back of the thigh just above the gluteal fold.

Amputations at the Hip-joint.

Operations.

1. Furneaux-Jordan.
2. Esmarch's modification of Furneaux-Jordan.
3. Lateral flaps.
4. Antero-posterior flaps (Guthrie).
5. Antero-posterior flaps by transfixion.

It is well to enumerate some of the methods of controlling hæmorrhage while performing these amputations at the hip-joint. In Furneaux-Jordan's amputation an ordinary tourniquet can be used; in the other operations some special method has to be adopted to control the vessels until they are ligatured. Any of the following may be employed.

1. Jordan-Lloyd's method consists of passing a stout elastic bandage round the hip; behind, it passes between the anus and tuber ischii, in front the ends of the bandage cross at a point above the iliac crest; a roller bandage is placed over the external iliac artery and held in place by the bandage. A reliable assistant holds the ends of the bandage.

2. The assistant makes firm pressure on the abdominal aorta through the abdominal wall, just at the umbilicus.

3. The common femoral is compressed by an assistant.

4. The vessels in the flap are secured before division.

5. The assistant follows the knife with his fingers and controls the vessels in the flap before they are cut, in the same way as in Spence's amputation at the shoulder.

1. Furneaux-Jordan's Method (Fig. 92).—The patient is brought well to the end of the couch, so that the buttocks almost overhang the table. The surgeon stands to the right of the limb to be removed, and the other leg is held out of the way. The femoral vessel is controlled. A circular incision is made through the skin about the middle of the thigh; a cuff of skin is then raised for about 2 inches. The remaining soft parts are divided with a circular cut down to the bone. The large vessels are then secured, and the surgeon makes a vertical cut from the circular incision up the outer side of the thigh to about 1½ inches above the great trochanter. This cut is made to the bone all along the femur. The soft parts are then cleared off the shaft of the femur up to the hip-joint, this being facilitated by strongly rotating the leg inwards or outwards as the case

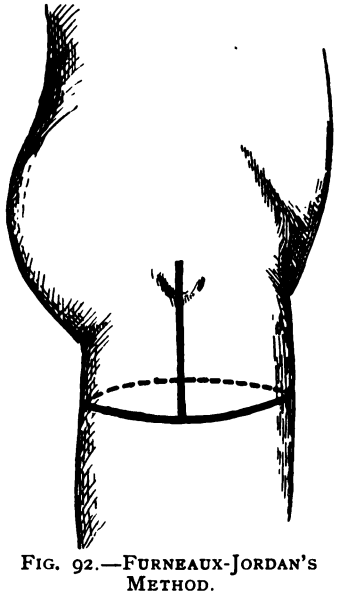

FIG. 92.—FURNEAUX-JORDAN'S METHOD.

may be. The capsule of the joint is then opened and disarticulation completed. Vessels requiring attention are the femoral, gluteal, sciatic, external and internal circumflex.

Memoranda.

I. See that the femoral artery is properly controlled while the operation is being performed.

II. Be careful while separating the soft parts from the head and shaft of the bone to keep very near it, both for fear of wounding any large vessel, and so as to save as much periosteum as possible when it is advantageous to do so.

2. Esmarch's Modification of the above consists of dividing the femur at the same time as effecting the circular division of the soft parts, and then dissecting out the upper part and head of the bone afterwards.

Another modification consists in first making the vertical incision along the outer part of the limb, disarticulating the hip-joint, separating some of the upper part of the femur and then sawing it off, and amputating on a level with the separation of the shaft of the femur.

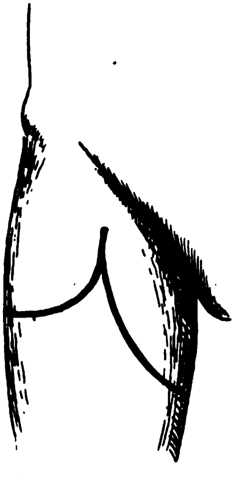

FIG. 93.—LATERAL FLAPS.

3. Lateral Flaps (Fig. 93). — The surgeon standing as before, the inner flap is commenced about the centre of Poupart's ligament, and the incision is carried vertically downwards for about 6 inches. It then curves inwards over the inner aspect of the thigh, and up the back of the thigh to the middle of the gluteal fold.

This incision divides only skin and cellular tissue. The femoral artery and vein are exposed in the vertical cut. An outer flap is then made, rather shorter than the inner one.

The skin flaps are dissected up. The muscles are separated on the outer part of the limb, then the muscles about the inner side of the limb are cut through to the bone. Lastly, the capsule of the joint is opened and the limb removed.

Memoranda.

I. Secure the femoral artery and vein in the vertical cut by two ligatures, and divide between.

II. As the muscular tissues are severed at the outer part of the limb, clip the vessels divided. In a similar way, while dealing with the posterior and likewise with the inner aspect of the limb, secure each vessel separately as it is cut.

4. Antero-Posterior Flaps (Guthrie's Method) (Fig. 94).—In this operation an anterior and a posterior flap are made. The anterior flap is commenced just above the great trochanter, is cut about 6 inches long, and ends just below the tuber ischii. The posterior flap is cut from the angles of the anterior one, and is about two-thirds its length. These skin flaps are retracted. The muscles on the front of the limb are divided, the vessels being secured, and the same is done with the muscles and vessels at the posterior aspect. The leg is then removed by disarticulation.

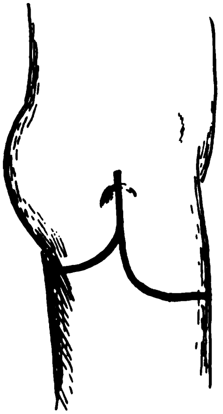

FIG. 94.—ANTERO-POSTERIOR FLAPS.

Memoranda.

I. Cut the anterior flap sufficiently long and broad.

II. Secure the main vessels at the anterior part of the stump before dividing the posterior muscles.

5. Transfixion.—This is hardly ever done now that anæsthetics are used.

The knife is entered midway between the anterior superior spine and the top of the trochanter, passes across the limb, and emerges close to the tuberosity of the ischium. The flap is then cut from within outwards. The hip-joint is opened, and the knife is passed behind the head of the bone, and the posterior flap cut in like manner.

CHAPTER VI

OSTEOTOMIES OF THE LOWER EXTREMITY

Osteotomy for Ankylosed Hip-Joint.

Operations.

1. Gant's operation.
2. Adam's operation.

1. Gant's Operation (Fig. 95).—The surgeon divides the femur below the trochanter. This is performed as follows: A knife is entered just below the great trochanter on the outer side of the limb, and carried to the bone. The wound is made about ½ an inch long. While the knife is in the wound a long narrow saw is introduced by its side to the anterior surface of the femur, and with it the bone is sawn three-quarters through and then fractured.

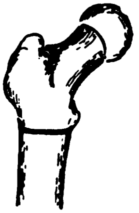

FIG. 95.—GANT'S OPERATION.

2. Adam's Operation (Fig. 96).—The surgeon divides only the neck of the femur. A long knife is entered just above the great trochanter and carried down to the neck of the femur. By the side of the knife an Adam's saw is introduced on to the front of the neck of the femur, and the knife being withdrawn, the neck of the bone is sawn almost through and then fractured.

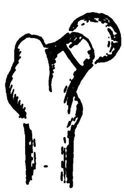

FIG. 96.—ADAM'S OPERATION.

Osteotomy for Knock-knee.

Anatomy (Fig. 65).

The epiphyseal cartilage is on a level with the tubercle of the adductor magnus tendon, on the inner side of the knee.

The synovial membrane of the knee-joint is in front of the lower end of the femur, and extends further up on the inner than on the outer side of the joint.

The popliteal artery is close to the bone at the lower part of the femur behind.

Operations.

1. Division of the femur from the outer side.
2. MacEwen's supracondyloid operation from the inner side.

1. Division of the Femur from the Outer Side.—This is probably the better operation. The patient is in the dorsal position, the knee flexed over a sand-bag. The surgeon stands on the outer side of the limb to be operated upon. An incision in the direction of the limb about an inch long is made about 3 inches above the external condyle. The knife is passed to the bone well towards the posterior aspect of the external surface of the femur. Before the knife is removed an Adam's saw is introduced on to the anterior surface of the femur, and the bone sawn three-quarters through, and the remainder fractured.

Memorandum.

If a chisel is used in dividing the femur instead of a saw, be careful that it does not slip and wound the popliteal artery.

2. MacEwen's Supracondyloid Operation from the Inner Side.—The knee is flexed and supported as before. At a point a finger's breadth above and ½ an inch in front of the adductor tubercle an incision about an inch long is made down to the bone. A chisel or saw is next introduced and the bone partly divided and fractured.

Wiring Fractured Patella.

Operation (Fig. 98).

A vertical incision about 4 inches long is made, or a skin flap turned up in any direction preferred. The joint is cleared of blood, and the upper and lower ends of the fractured patella are refreshed, all the fibrous tissue intervening between the ends of the bones being removed. The upper and lower fragments are drilled in such a way that the wire does not pass through the posterior aspect of the patella. The wires issuing from the fragments are twisted tightly together. The ends are hammered down.

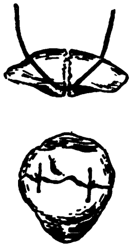

Fig. 97. — Method of Inserting Wires for Uniting a Fractured Patella.

Excisions of the shaft of the femur, tibia, or fibula and metatarsal bones are conducted on very much the same lines as in the case of the corresponding bones of the upper extremity.

PART III

CHAPTER I

LIGATURE OF THE VESSELS OF THE HEAD AND NECK

COMMON CAROTID.

THE artery extends from the upper border of the thyroid cartilage downwards into the chest. It is represented by a line drawn from a point midway between the angle of the jaw and the mastoid process to the sterno-clavicular articulation.

Ligature of the Common Carotid Artery.

ANATOMY (Fig. 98).

In Front.

Skin, fascia, platysma.
The facial, lingual, and superior thyroid veins.
Descendens noni nerve.
Sterno-mastoid, sterno-hyoid, and sterno-thyroid muscles.

Outer Side.		*Inner Side.*
Internal jugular vein.	**[Artery.]**	Pharynx, larynx, and trachea. Thyroid gland. Recurrent laryngeal nerve.

Behind.

Rectus capitis anticus major and longus colli muscles.
Pneumogastric and sympathetic nerves.
Low down in neck, inferior thyroid artery
and recurrent laryngeal nerve.

The omo-hyoid muscle generally crosses the vessel on a level with the cricoid cartilage.

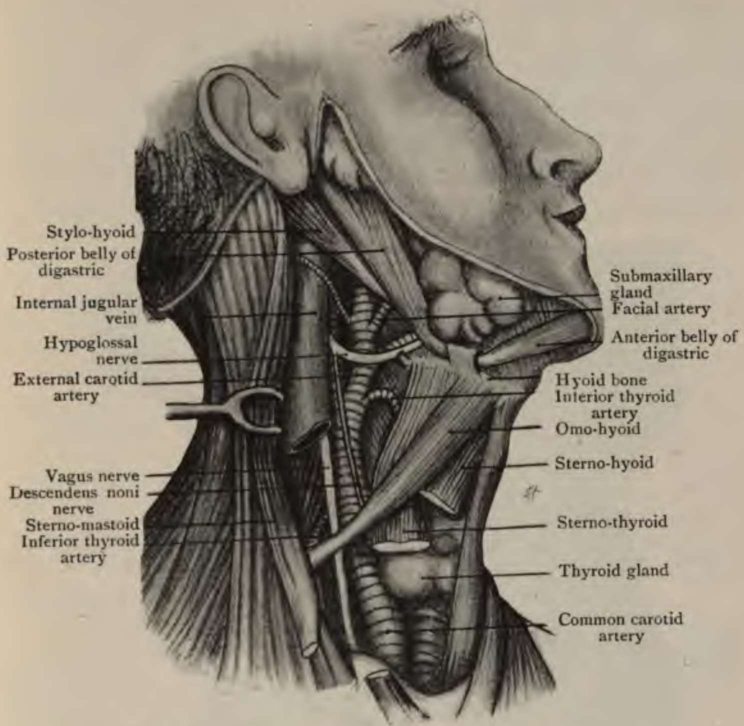

FIG. 98.—ANATOMY OF THE CAROTID ARTERIES.

Operation.

The operation is performed either above or below the omo-hyoid.

Operation above the Omo-hyoid (Fig. 99). — The patient is placed on his back, the shoulder raised, the head turned towards the opposite side, and the chin raised. The operator, standing on the side of the neck to be operated upon, makes an incision about 3 inches long in the line of the vessel, the centre of the cut being on a level with the cricoid cartilage. The skin, fascia, and platysma are divided. The deep fascia is divided carefully, and the anterior border of the sterno-mastoid is found. This is drawn slightly outwards; the cellular tissue is freed with the handle of the knife. In this way the omo-hyoid is exposed, and it may be drawn downwards or divided if in the way. The sheath of the vessel is then exposed. If the descendens noni nerve is seen, it is drawn aside, and the pulsating carotid felt for. Attention should next be directed to the inner aspect of the sheath of the vessel. It is opened, and the vessel very carefully cleared by a director inserted first to one side of it and then to the other. The needle is passed from without inwards.

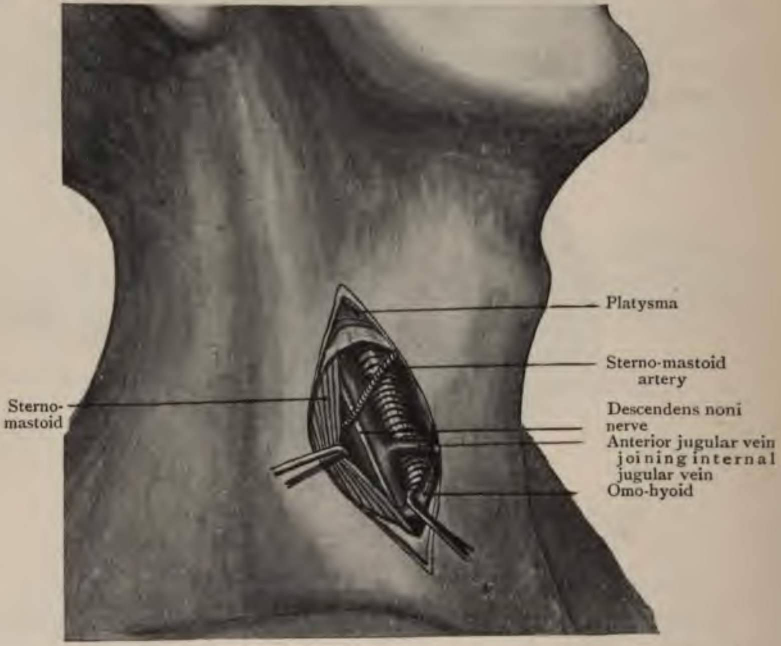

FIG. 99.—LIGATURE OF THE COMMON CAROTID ABOVE THE OMO-HYOID.

Operation below the Omo-hyoid.—This is the same as the preceding operation, except that the incision here is begun just below the cricoid cartilage, and is extended in the line of the vessel to the sterno-clavicular joint. Sometimes it is necessary to divide the sternal attachment of the sterno-mastoid, so as to give room.

The rest of the operation is as above described, care here being taken of the large inferior thyroid and anterior jugular veins. The recurrent laryngeal nerve lies just behind the artery, and must not be included in the ligature.

Collateral Circulation.

Superior thyroid,
lingual, facial, and occipital + corresponding vessels of opposite side.
Superior thyroid + inferior thyroid.
Vertebral + vertebral.
Princeps cervicis of occipital + deep cervical branch of superior intercostal.

Memoranda.

I. In ligaturing the carotid, a good practical line for the vessel is the anterior border of the sterno-mastoid.

II. Do not turn the head too far to the opposite side, for fear of pulling the sterno-mastoid muscle over the vessel, and thus missing the anterior edge, after dividing the deep fascia in the line of the vessel.

III. Several veins may cross the artery; they must be retracted or divided. The same applies to the small sterno-mastoid artery.

IV. Remember that the internal jugular vein is not only to the outer side of the artery, but that it greatly overlaps it in front, so that the sheath of the vessel must be opened well to the *inner* side so as to avoid wounding the vein. This accident might occur if an attempt were made to open the sheath on its anterior or outer aspect.

V. Avoid including in the ligature of the vessel the descendens noni, pneumogastric, sympathetic, or the recurrent laryngeal nerves. In other words, the aneurism needle must be kept closely in contact with the vessel in passing it.

INTERNAL CAROTID.

The internal carotid extends from the division of the common carotid, which is on a level with the upper border of the thyroid cartilage, to the carotid canal in the base of the skull. The line of the vessel is practically that of the common carotid, the internal carotid lying rather behind and outside the external carotid.

Ligature of the Internal Carotid Artery.

ANATOMY (Fig. 98).

In Front.

Skin, fascia, platysma.
Sterno-mastoid, stylo-glossus, and stylo-pharyngeus muscles.
Glosso-pharyngeal nerve.
Parotid gland.

Outer Side.		*Inner Side.*
Internal jugular vein.		Ascending pharyngeal artery.
Pneumogastric nerve.	**[Artery.]**	Pharynx.
		Tonsil.

Behind.

Superior laryngeal nerve.
Rectus capitis anticus major.

Operation.

As this vessel can only be tied just after it leaves the common carotid, the method of ligaturing it is almost exactly the same as that for the external carotid, to be next described. An incision is made in the line of the vessel just over the anterior edge of the sterno-mastoid; the centre of the incision is on a level with the upper edge of the thyroid cartilage. The external carotid is found and pulled inwards, the internal exposed and ligatured close to its origin. The needle is passed from within outwards.

EXTERNAL CAROTID.

It extends from the bifurcation of the common carotid up the neck to the back of the condyle of the jaw, where it divides into its terminal branches, the temporal and internal maxillary arteries. The line of the vessel is the same as that of the common carotid.

Ligature of the External Carotid Artery.

ANATOMY (Fig. 98).

Superficial.

Skin, fascia, platysma.
Superficial veins and nerves.
Hypoglossal nerve.
Lingual and facial veins.
Stylo-hyoid and digastric muscles.
Higher up, the parotid gland and facial nerve.

Behind.		*In Front.*
Ear.	**[Arteries.]**	Pharynx. Hyoid bone. Ramus of jaw.

Deep.

Superior laryngeal and glosso-pharyngeal nerves.
Stylo-glossus and stylo-pharyngeus muscles.

Operation.

1. Below the digastric muscle.
2. Above the digastric.

1. Below the Digastric Muscle (Fig. 100). — The patient's head is turned to the opposite side and extended, the surgeon stands on the side to be operated upon. An incision about 3 inches long is made in the line of the vessel, having its centre about on a level with the great cornu of the hyoid bone. The superficial structures are divided, and the anterior edge of the sterno-mastoid exposed. The posterior belly of the digastric muscle and the hypoglossal nerve are sought for. The sterno-mastoid is drawn outwards, and the pulsation of the vessel should be felt for. The vessel should be exposed by a director just on a level with the great cornu of the hyoid bone. When found, a point is to be selected between the giving off of the superior thyroid and lingual vessels, and the artery ligatured, the needle being passed from without inwards.

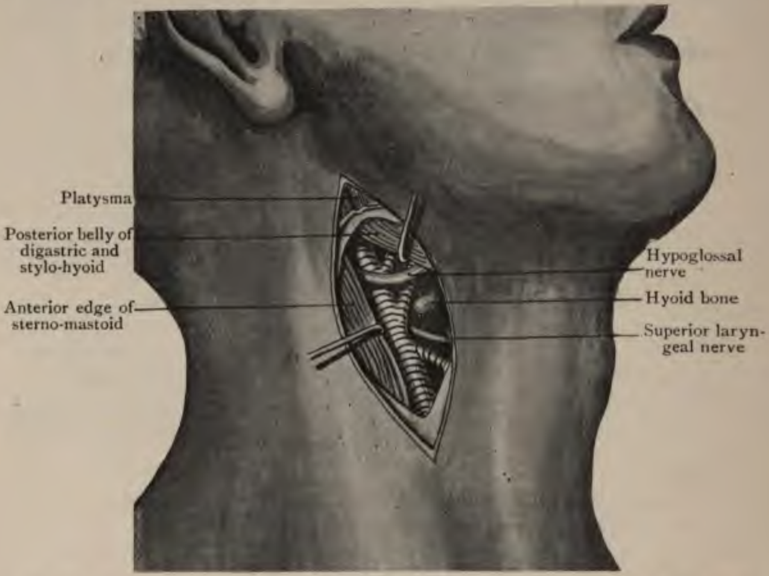
Platysma
Posterior belly of digastric and stylo-hyoid
Anterior edge of sterno-mastoid
Hypoglossal nerve
Hyoid bone
Superior laryngeal nerve

FIG. 100.—LIGATURE OF THE EXTERNAL CAROTID BELOW THE DIGASTRIC.

2. Above the Digastric Muscle.—An incision is made from the tragus of the ear to just behind and below the ramus of the jaw. The sterno-mastoid is exposed and drawn outwards. The digastric and stylo-hyoid are drawn downwards, or even divided somewhat, so as to give space. The external carotid is then found just entering the substance of the parotid gland, and is ligatured below that point.

Memoranda.

I. Take care of the many large veins running over and in relation with this vessel. Carefully retract, or divide and ligature them if they are in the way.

II. Remember when ligaturing the carotid to secure also any large branches given off from the vessel close to the point of ligature—namely, the thyroid and lingual, one or both.

III. Remember to distinguish the internal from the external carotid, if both should be exposed. The external has branches in the neck, the internal none.

IV. The hypoglossal nerve is a most important guide to the artery.

SUPERIOR THYROID ARTERY.

To ligature this vessel requires practically the same operation as that for ligature of the external carotid. The latter is found in the usual way, and the artery is sought for, proceeding from the main trunk, and ligatured a little way from it.

LINGUAL ARTERY.

It arises from the external carotid immediately above the superior thyroid artery, runs up to the great cornu of the hyoid bone, and passes for some way along the upper surface of the cornu. It then ascends to the under surface of the tongue. The artery may be divided into three portions.

The best place to ligature the vessel is under the hyoglossus muscle in its second part.

Ligature of the Lingual Artery under the Hyoglossus Muscle.

ANATOMY.

Relations of the Second Part.

Superficial.

Hyoglossus muscle.
Part of the mylo-hyoid.
Submaxillary gland.
Hypoglossal nerve.

[Artery.]

Deep.

Middle constrictor of pharynx.

Operation (Fig. 101).

The shoulders are raised, the head turned to the opposite side, the chin raised, and the mouth kept shut. The surgeon stands on the side to be operated upon. A curved incision is made from about the symphysis of the jaw to the position where the facial artery crosses the lower jaw (1 inch in front of the angle of the jaw). The centre of this curved incision is over the great cornu of the hyoid bone. The skin and fascia and platysma are divided, and the submaxillary gland exposed, freed, and turned upwards over the lower jaw. The tendon of the digastric muscle is then exposed at its attachment to the hyoid bone, and the hypoglossal nerve is sought for. The nerve is drawn upwards, the digastric tendon and the hyoid bone drawn downwards. It may be mentioned that towards the front of the area so exposed is seen the anterior edge of the mylo-hyoid muscle. The cellular tissue over the hyoglossus is scratched through and the muscular fibres exposed. These are most carefully divided for about

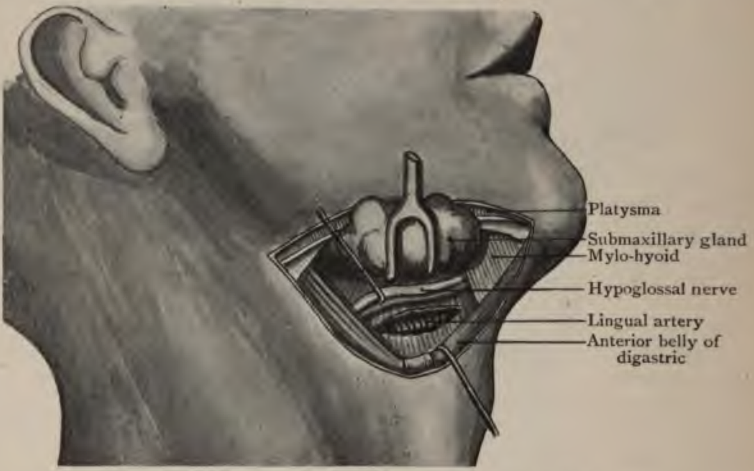

FIG. 101.—LIGATURE OF THE LINGUAL ARTERY.

½ inch parallel to and just above the hyoid bone; the vessel will then probably bulge into the wound. The aneurism needle is passed and the vessel secured.

Memoranda.

I. Do not wound the submaxillary gland, as a troublesome salivary fistula may result.

II. Always find the hypoglossal nerve, as it is a valuable guide to the vessel, since it rests on the hyoglossus muscle, and above that part of the muscle beneath which the vessel lies.

III. Remember that the hyoglossus muscle varies greatly in thickness.

IV. Be careful not to cut right through the hyoglossus, and then divide the middle constrictor of the pharynx, so opening the pharynx, mistaking it for the hyoglossus muscle.

FACIAL ARTERY.

Anatomy.

It is given off in the neck just above the lingual artery, passes up to the submaxillary gland, crosses the jaw at the anterior edge of the masseter, and goes across the side of the face, to the angle of the eye.

Ligature of the Facial Artery.

Operation.

A small horizontal incision is made along the lower edge of the jaw just at the anterior edge of the masseter. The skin, fascia, and platysma are divided; the artery is exposed and ligatured.

Memoranda.

I. As the artery is quite superficial, care must be taken that it is not divided when the cut is made down upon it.

II. If any branches of the facial nerve be met with, do not divide them.

OCCIPITAL ARTERY.

It comes off from the external carotid artery, opposite to the facial, and first passes between the transverse process of the atlas and the mastoid process. It then turns horizontally backwards, and lastly turns vertically upwards.

Ligature of the Occipital Artery.

ANATOMY.

Relations of the First Part.

In Front.		*Behind.*
Digastric.		Internal carotid.
Stylo-hyoid.	[**Artery.**]	Vagus and the accessory nerves.
Parotid gland.		Internal jugular vein.

Relations of the Second Part.

Superficial.		*Deep.*
Sterno-mastoid muscle.		Complexus.
Splenius muscle.	[**Artery.**]	
Digastric.		
Trachelo-mastoid muscle.		

Operations.

1. Ligature in the second part of its course.
2. Ligature in the first part of its course.

1. Ligature in the Second Part.—An incision is made from the mastoid process in a direction upwards towards the external occipital protuberance. The skin and muscles enumerated above are divided, and the vessel found lying on the complexus, or between the mastoid process and the transverse process of the atlas.

2. Ligature in the First Part.—An incision is made as for ligature of the external carotid; the vessel will be found coming off from its posterior aspect opposite to the facial artery.

Memorandum.

In ligaturing the first part care should be taken to avoid wounding the ninth nerve.

TEMPORAL ARTERY.

Anatomy.

The line of the vessel is one drawn upwards midway between the tragus and the condyle of the jaw above the zygoma.

Ligature of the Temporal Artery.

Operation.

An incision about an inch long is made in the line of the artery just over the zygoma. The skin and tough fascia are divided, and the vessel exposed and ligatured, the needle being passed from behind forwards.

Memoranda.

Do not damage any branches of the facial nerve. If they are met, retract them. Also, when passing the aneurism needle, do not include the auriculo-temporal nerve, which is just posterior to the artery.

SUBCLAVIAN ARTERY.

On the *right* side it extends from the innominate artery, behind the right sterno-clavicular articulation, outwards to the outer margin of the first rib, where it becomes axillary.

On the *left* side it issues from the arch of the aorta, and terminates at the outer margin of the first rib.

The surface marking is indicated by a curved line extending from the sterno-clavicular joint to about the centre of the clavicle, the centre of the curve being about an inch above the clavicle.

The subclavian, for anatomical purposes, is divided into three portions: First portion, from the origin of the artery to the inner margin of the scalenus anticus; second, that piece of the vessel behind the scalenus anticus; third, the piece from the outer margin of the scalenus anticus to the outer margin of the first rib.

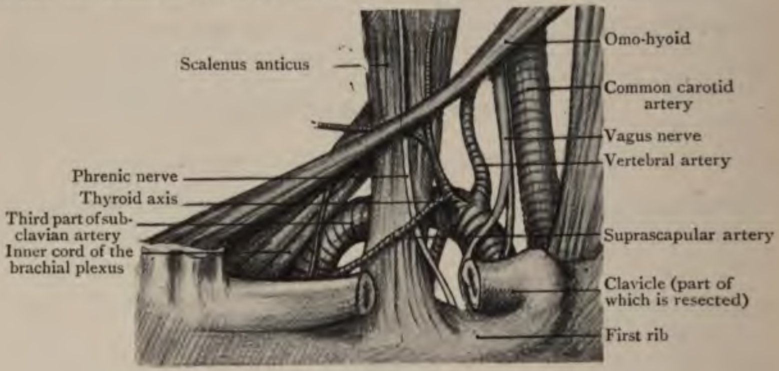

FIG. 102.—ANATOMY OF THE SUBCLAVIAN ARTERY.

Ligature of the Subclavian Artery.

ANATOMY (Fig. 102).

Relations of the Second Part.

In Front.

Skin, fascia, platysma.
Sterno-mastoid.
Scalenus anticus.
Phrenic nerve.
Subclavian vein.

Above.
Brachial plexus.

[Artery.]

Below and inner side.
Pleura.
Subclavian vein.

Behind.
Scalenus medius and pleura.

Relations of the Third Part.

In Front.

Skin, fascia, platysma.
External jugular and numerous other small veins and suprascapular artery.

Above.
Omo-hyoid.
Brachial plexus.

[Artery.]

Below.
First rib.
Subclavian vein.

Behind.
The scalenus medius muscle.

Operation.

The operator stands towards the front of the side to be operated upon. The patient lies on the back, the chest raised, the head extended and turned to the opposite side. The arm is pulled well down. The skin is drawn down with the left hand, and an incision 3 inches long is made over the clavicle about its centre—that is to say, between the sterno-mastoid and the trapezius. By this incision the soft parts are divided nearly to the bone; the skin is allowed to retract, and the cut will then be situated about ½ inch above the clavicle. The deep fascia is divided for the entire length of the wound, the external jugular vein being retracted, or secured and divided between two ligatures. The soft cellular tissue is opened up with the handle of the knife, any veins being

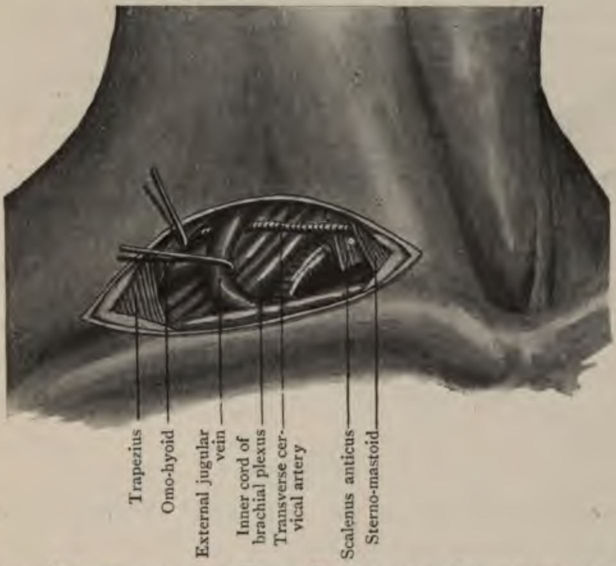

FIG. 103.—LIGATURE OF THE THIRD PART OF THE SUBCLAVIAN ARTERY. The vein can be seen in the drawing lying just below the artery and in front of the scalenus anticus.

carefully avoided, and the outer edge of the scalenus anticus is found. This is traced downwards to its tubercle on the first rib, and just below and behind this the artery is to be found. The lower cord of the brachial plexus is seen just above, or even resting on, the vessel. The artery being made out, the sheath is opened and the vessel freed, the needle being passed from above downwards and from behind forwards.

If the third part of the artery is diseased or too near to the aneurismal sac, the second part may be ligatured. The operation is the same, except that some of the sterno-mastoid and the scalenus anticus may have to be divided to give room.

No description will be given of the ligaturing of the first part of the subclavian, for it is doubtful, considering the small piece of the vessel and the very numerous branches coming off from it, whether it is justifiable to ligature it.

Collateral Circulation.

Superior intercostal + suprascapular.
Aortic + long thoracic.
Posterior scapular + infrascapular and subscapular.
Suprascapular + acromio thoracic.

Memoranda.

I. Always draw down the skin while dividing it, as by so doing the external jugular vein is not wounded. If room is wanted, divide some of the attachments of sterno-mastoid and trapezius.

II. Be careful not to prick with the knife any of the numerous veins met with ; retract or divide them between two ligatures if they are in the way.

III. Do not mistake the suprascapular or transversalis coli for the artery. Moreover, do not injure them, as they are required for the collateral circulation.

IV. Remember not to mistake the lower cord of the brachial plexus for the artery, and do not include it in the ligature.

V. In passing the aneurism needle use no force, and see that the subclavian vein is not wounded in front or the pleura below.

VI. In ligaturing the second portion of the artery, be most careful of the phrenic nerve, which lies on the scalenus anticus muscle.

VERTEBRAL ARTERY.

The artery is deeply seated in the neck, arising from the first part of the subclavian. It travels up the neck, and enters the transverse process of the sixth cervical vertebra, where it passes to the base of the brain through the remaining upper transverse processes.

The surface marking of the vessel is the lower half of the posterior margin of the sterno-mastoid.

Ligature of the Vertebral Artery.

ANATOMY.

In Front.

Internal jugular and inferior thyroid veins.
Vertebral vein.
Sympathetic plexus.
Thoracic duct on left side.

Outer Side.		*Inner Side.*
Scalenus anticus and phrenic nerve.	**[Artery.]**	Longus coli.

Behind.

Cervical nerves in vertebral canal.

Operation.

The patient is placed in the same position as for ligature of the subclavian artery. An incision is made from the clavicle upward along the posterior edge of the sterno-mastoid for quite 3 inches. The deep fascia being divided, the sterno-mastoid and external jugular veins are drawn inwards. The clavicular attachment of the sterno-mastoid has often to be divided in order to give enough room. The scalenus anticus is then found, and a search along its inner border between it and the longus coli muscle is made for the vessel. The transverse process of the sixth cervical vertebra is a good guide in this search. The vessel being found, it is cleared of veins, and, with great care of the branches of the sympathetic nerves, the aneurism needle is passed, and the vessel is secured.

Memoranda.

I. The vessel lies between the scalenus anticus and longus coli muscles.

II. Do not wound any of the important structures lying over and near the artery—viz., the thoracic duct on the left side, and inferior thyroid vein, etc.

III. Do not mistake the inferior thyroid artery or the ascending cervical artery for the vessel. The vessel itself is well between the two muscles already mentioned, and enters the foramen in the transverse process of the sixth cervical vertebra.

INFERIOR THYROID ARTERY.

Operation.

An incision is made as for ligaturing the common carotid, extending to the clavicle. The sterno-mastoid and carotid vessels are drawn outwards, and the vessel is found near the transverse process of the sixth cervical vertebra, running in an inward direction.

Memorandum.

Keep in mind the recurrent laryngeal nerve.

INNOMINATE ARTERY.

The vessel issues from the arch of the aorta, and extends from left to right to the right sterno-clavicular articulation. The superficial line of the vessel is from the junction of the manubrium with the second piece of the sternum to the right sterno-clavicular joint.

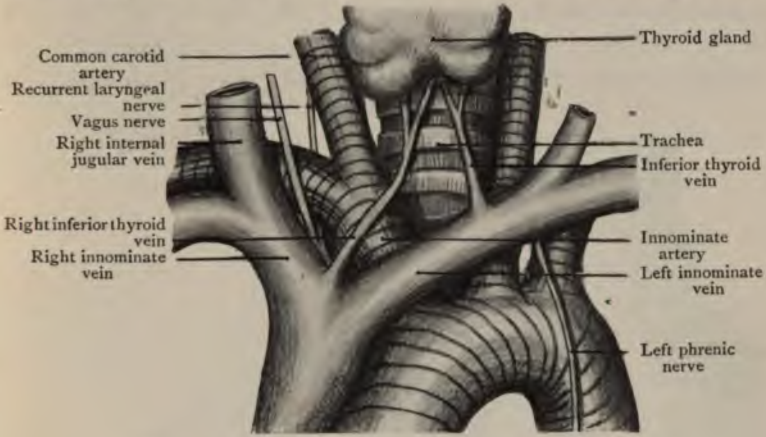

FIG. 104.—ANATOMY OF THE INNOMINATE ARTERY.

Ligature of the Innominate Artery.

ANATOMY (Fig. 104).

In Front.
Sternum.
Sterno-hyoid and thyroid.
Left innominate and right inferior thyroid veins.

Outer Side.		*Inner Side.*
Right innominate vein. Pneumogastric nerve. Pleura.	[**Artery.**]	Left carotid.

Behind.
Trachea.

Operation (Fig. 105).

The patient being in exactly the same position as for tying the subclavian artery, an incision at least 3 inches long is made along the lower part of the sterno-mastoid on its anterior border. From the extremity of this, an incision is carried outwards along the inner third of the clavicle ; the flap is then turned up. The sterno-mastoid is divided, and the sterno-thyroid and hyoid are exposed and also divided. The muscles retract and are held out of the way. The deep cervical fascia is opened; the carotid is found and its sheath opened on its inner side, and the vessel traced down to its junction with the innominate. The artery, which is always reached with great difficulty, is cleared of its important structures, especially those in relation with the outer side.

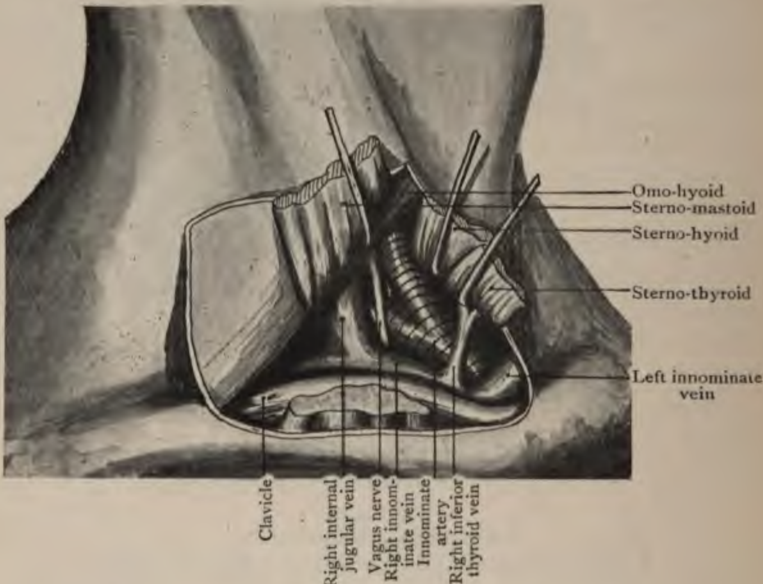

FIG. 105.—LIGATURE OF THE INNOMINATE ARTERY.

For the purposes of the diagram it has been necessary to show the innominate artery much higher above the clavicle than is actually the case. The relations are as shown, but the operator would find the vessel much below the clavicle and at a considerable depth from the surface.

The aneurism needle is passed loaded with silk away from the vein, and any ligature that is about to be used is drawn round by the silk. The vessel is then tied with great gentleness.

Lastly, the common carotid should be ligatured about an inch from the innominate.

This description is short, but the operation is necessarily a very long one, and is extremely difficult on account of the enormous veins and important structures running over and near the vessel, and on account of the depth of the wound. In order to get more room it may be necessary to remove some of the upper part of the sternum.

Memoranda.

I. In tracing down the common carotid sheath, keep the director on the front of the artery.

II. Be most careful not to puncture any large veins or to wound the pleura.

III. Do not forget to ligature the carotid. If this is not done, the reflux of blood from the other side of the head and neck may disturb the clot about the ligature of the innominate.

IV. Tie the ligature very gently, so as not to injure the internal coat of the artery.

V. Be careful not to include the vagus in the ligature.

CHAPTER II

NERVES OF THE HEAD AND NECK

FIFTH NERVE.

Anatomy.

AFTER the nerve leaves the brain, it passes on to the upper surface of the petrous portion of the temporal bone and becomes connected with the Gasserian ganglion. It then separates into its three divisions. The first passes through the sphenoidal fissure, and ends in three terminal sensory branches—viz., nasal, supratrochlear, and surpra-orbital.

The second division, the superior maxillary, passes through the foramen rotundum, across the spheno-maxillary fossa, joining here with Meckel's ganglion. It enters the orbit by the infra-orbital canal, and passes out through the infra-orbital foramen, dividing into its terminal branches, which supply sensory filaments to the upper part of the cheek, ala of the nose, and upper lip.

The third division passes through the foramen ovale and divides into branches, three of which need description, as they may require to be divided. One, the inferior dental, runs downwards and enters the dental foramen on the inner surface of the vertical ramus of the lower jaw. Thence it travels in a canal in the lower jaw, and emerges at the mental foramen.

Another branch of the third division—namely, the buccal—passes down along the inner surface of the coronoid process of the lower jaw, and through the fibres of the temporal muscle into the buccinator muscle, where it divides into its terminal filaments.

The other branch which is of surgical interest is the lingual branch. This passes between the internal pterygoid muscle and the jaw, and crosses obliquely to the side of the tongue, passing across the inner angle of the jaw.

The points of exit of these three divisions of the fifth nerve from their foramina on the face are represented by a line drawn from the junction of the inner third with the middle third of the supra-orbital arch. From this point the line is drawn between the two bicuspid teeth of the upper and lower jaws. The infra-orbital foramen is about $\frac{1}{4}$ inch below the lower margin of the orbit, and the dental foramen is midway between the alveolus and the lower margin of the jaw.

Supra-Orbital Nerve.

Operation (Fig. 106).

This is performed by means of an incision 1 inch in length, made horizontal to the upper margin of the orbit about its inner part. The centre of the incision is over the point of exit of the nerve. The skin is steadied, and the integuments and orbicularis muscle being cut through, the nerve is found and dealt with as seems necessary—namely, stretched, divided, or a piece cut out.

Infra-Orbital Nerve.

Operations (Fig. 106).

1. On the face.
2. In the infra-orbital canal.

1. On the Face.—A transverse incision is made about an inch long just below the orbit. The skin is pulled down and the nerve exposed as it issues from the infra-orbital foramen, about $\frac{1}{4}$ of an inch below the lower margin of the orbit. The skin cut being pulled down, the fat is cleared away and the nerve found. The orbicularis and the levator labii superioris are divided.

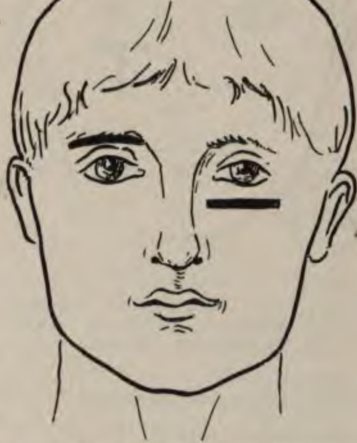

FIG. 106.—INCISIONS FOR EXPOSING THE SUPRA-ORBITAL AND INFRA-ORBITAL NERVES.

2. In the Infra-Orbital Canal.—In this operation the incision is made along the lower margin of the orbit. The periosteum of the orbit is raised and the small canal chiselled away, or cut into by strong scissors; thus the nerve is exposed and treated as needed.

Superior Maxillary Nerve and Meckel's Ganglion.

Operation (Fig. 107).

An incision, **T** or **V** shaped, is made on the face; the upper part of the **T** corresponds with the lower margin of the orbit, and extends from one canthus to the other. The long arm of the **T** is made over the infra-orbital foramen; the flaps are turned backwards. The infra-orbital nerve is then found by the method already described, and a small piece of silk tied firmly to its end. A ½-inch trephine is then applied to the anterior wall of the antrum immediately below the exit of the nerve and the antrum opened; with cutting bone forceps the nerve is freed from its foramen. The antrum being open, a ¼-inch trephine is applied to its posterior wall, and thus the spheno-maxillary fossa exposed. Next the mucous membrane along the roof of the antrum is divided, the bone forming the floor of the infra-orbital canal cut away with bone forceps, and the nerve by this means entirely freed.

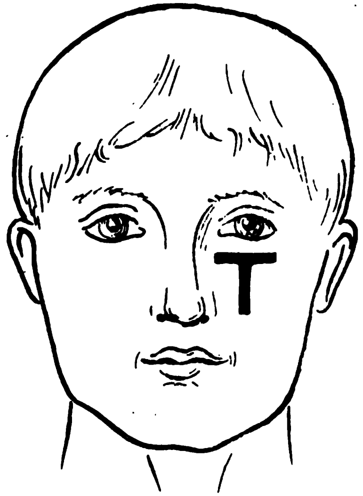

FIG. 107.—INCISION FOR EXPOSING THE SUPERIOR MAXILLARY NERVE AND MECKEL'S GANGLION.

The nerve, being freed from the spheno-maxillary fossa, is gently pulled upon, in order as far as possible to indicate its exit from the foramen rotundum. While it is tense small scissors are passed along it right to the back part of the spheno-maxillary fossa, and the nerve divided as close to the bone as possible. Other small filaments that may prevent it coming freely away are also divided.

By operating in this way the nerve ganglion is probably removed as well.

Memoranda.

I. Be careful not to divide the nerve during its exposure.

II. In freeing it from the infra-orbital canal, the infra-orbital vessels will probably be divided. This is of no moment; the vessels can be controlled by sponge pressure or temporary plugging with gauze.

III. A mirror or forehead lamp will often be found useful.

Inferior Dental Nerve.

Operations.

1. At the mental foramen.
2. In the dental canal.
3. At the dental foramen.

1. At the Mental Foramen.—Remember that the mental foramen is in a line drawn between the two lower bicuspid teeth, and midway between the edge of the gum and the lower margin of the jaw. The mouth being open and the lip well retracted, the mucous membrane outside the jaw is divided, and the nerve then exposed and divided, or the crown of a trephine may be applied to the jaw just below the mental foramen and the outer layer of the bone removed. The nerve is thus exposed in the jaw, and treated by stretching, division, or resecting a piece.

2. In the Dental Canal (Fig. 108).—A vertical incision is made 2 inches long through the skin over the vertical ramus of the jaw about its centre, commencing ½ an inch below the zygoma. The soft parts are separated from the bone, a ½-inch trephine applied, and the bone crown removed. The dental nerve is then hooked up through the trephine hole and dealt with.

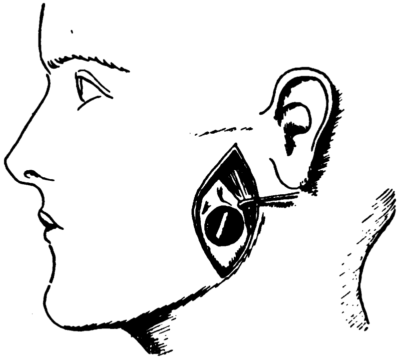

FIG. 108.—THE INFERIOR DENTAL NERVE EXPOSED BY TREPHINING THE JAW.
The masseter is shown drawn back with a hook.

Memoranda.

I. Be careful to avoid the facial nerve. Let the superficial cut be only skin-deep.

II. In trephining the bone do not use too much force, or the jaw may be fractured.

3. At the Dental Foramen (Fig. 109).—The mouth is opened by a gag, and the cheek retracted on the side to be operated upon. The ascending ramus of the jaw is marked out with the finger, and an incision is made through the mucous membrane over the edge of the ramus. This incision is made to the bone. With an elevator the soft parts are turned off the inner surface of the bone. The spine of Spinx is felt for; the internal lateral ligament, which is attached to it, is divided. The nerve is found, pulled forwards with a hook and stretched or divided.

Memoranda.

I. The nerve is in close relation with the dental vessels, and must be isolated from them before division.

II. Do not divide the nerve too high up, or the internal maxillary artery may be wounded.

III. The key to the operation is the spine of Spinx.

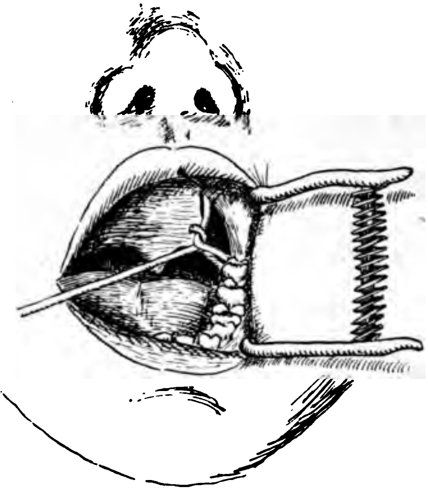

FIG. 109.—EXPOSURE OF THE INFERIOR DENTAL NERVE FROM THE MOUTH. The nerve is shown caught up in the hook.

Buccal Nerve.

Operation.

From inside the mouth the centre of the anterior border of the ascending ramus of the jaw is made out; the mucous membrane and a few fibres of the buccinator are divided just in front of this point by a vertical incision. The nerve is then sought for amongst the fibres of the buccinator.

Lingual Nerve.

Operation.

The mouth is opened widely by a gag, and the tongue drawn to the opposite side to the one to be operated upon. The mucous membrane is divided across a line extending from the last molar tooth to the angle of the jaw. The pulling of the tongue to the opposite side often makes the nerve prominent. It is found in the incision, and a piece excised or stretched as the case may require.

Memorandum.

The nerve can usually be felt with the finger.

Operation on the Trunk Proper of the Inferior Maxillary Nerve at its Exit from the Foramen Ovale—Kronlein's Operation (Figs. 110 and 111).

A square flap is made, the base being downwards, and the two arms extending up to just above the zygoma. These vertical incisions are immediately over the anterior and posterior edges of the vertical ramus of the jaw, and are joined by a transverse incision just above the zygoma. The flap is turned down, containing all the structures as far as the masseter muscle. The zygoma is then sawn through in a line with the vertical incisions, and is turned down with the masseter attached to it, and freed well from the jaw. The coronoid process is divided, together with the attachment of

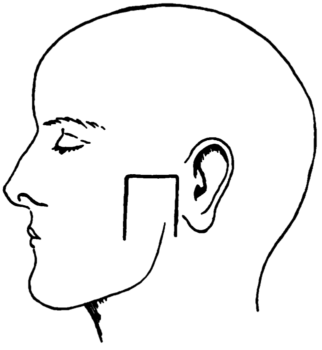

FIG. 110.—KRONLEIN'S OPERATION.

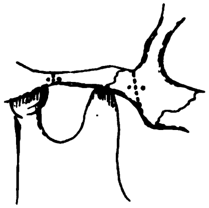

FIG. 111.—SHOWING THE LINES OF THE SAW-CUTS FOR DIVIDING THE ZYGOMA.

The drill-holes for wiring it later are shown drilled first, so as to insure accurate apposition.

the temporal muscle, and turned upwards; then attention is directed to the *upper* head of the external pterygoid at its attachment to the sphenoid. This head is severed, and the nerve is found issuing from the skull, and divided.

Memoranda.

I. Do not wound the facial nerve or Steno's duct in the skin incision; divide only the skin, and then rather forcibly retract the soft parts.

II. There is generally troublesome bleeding, hence every vessel must be well secured before proceeding to each step in the operation.

Removal of the Gasserian Ganglion.

Operations.

1. Extracranial method (Rose).
2. Intracranial method (Horsley).

1. **Rose's Operation.**—An incision is made from the outer canthus of the eye backwards along the upper border of the zygoma to the ear, and then downwards to the angle of the jaw. The zygoma and coronoid processes of the jaw are cut through and turned aside. The internal maxillary artery is exposed and divided between ligatures, the external pterygoid muscle is carefully dissected off the bone, and the foramen ovale exposed. A disc of bone is next removed just anterior and external to the foramen; this opening is then enlarged with suitable forceps, and by tracing up the inferior maxillary division of the nerve the ganglion is found.

2. **Horsley's Operation.**—A large temporal flap is made with its base downwards, so as to expose the squamous portion of the temporal bone, which is removed with a trephine and forceps. The middle meningeal artery is divided between ligatures. The dura mater is incised, and the temporo-sphenoidal lobe raised by means of a flat spatula; the

ganglion is then sought for on the upper surface of the petrous bone.

FACIAL NERVE.

Anatomy.

Passing through the canal in the temporal bone, the nerve emerges from the stylo-mastoid foramen, which is situated between the base of the styloid and mastoid processes in front of the posterior attachment of the digastric muscle. It then runs forwards in the parotid gland, crosses the external carotid artery, and breaks up into its branches, which supply the muscles of the face.

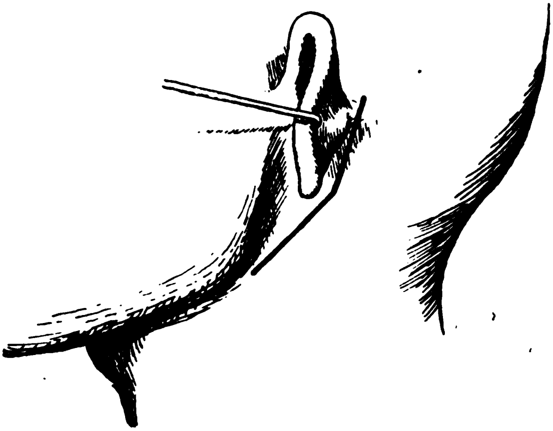

FIG. 112.—INCISION FOR EXPOSURE OF THE FACIAL NERVE.

Operation (Fig. 112).

An incision is begun just behind the ear, opposite the external meatus. This is carried downwards and forwards to a point below the lobe of the ear, and thence is prolonged downwards and slightly forwards to about the angle of the jaw.

If necessary, a small transverse incision is also made below the ear. These flaps are dissected up, and the anterior edge of the sterno-mastoid exposed. This muscle is drawn backwards, and the parotid forwards. The posterior belly of the digastric is exposed, and about its anterior edge the cellular tissue is carefully separated by the handle of the knife, and thus the nerve is reached as it issues from its foramen.

SPINAL ACCESSORY NERVE.

Anatomy (Fig. 113).

The nerve comes out of the jugular foramen, and turns backwards behind the internal jugular vein and appears below the digastric muscle. It turns outwards to the sterno-mastoid and enters part of it about 2 inches below the mastoid process; having passed through the sterno-mastoid, it emerges from its posterior border about the centre of the muscle. It crosses the posterior triangle of the neck, and ends in the trapezius muscle at a spot on about a level with the spine of the sixth cervical vertebra.

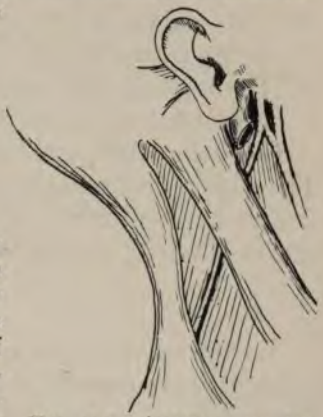

FIG. 113.—ANATOMY OF THE SPINAL ACCESSORY NERVE.

The nerve is shown passing behind the jugular vein (cut short), and then passing across the posterior triangle of the neck, after piercing the sterno-mastoid.

Operation.

The nerve is best dealt with at the anterior border of the sterno-mastoid muscle, as it enters it. An incision 3 inches long is commenced at the apex of the mastoid process and continued downwards along the anterior border of the muscle. The superficial structures being divided, the anterior edge of the muscle is defined, and the nerve is then readily found and dealt with.

Memorandum.

Retract forcibly the sterno-mastoid backwards, for by this the nerve is made tense and can easily be found.

BRACHIAL PLEXUS.

Anatomy.

This may be represented by a line drawn from about the cricoid cartilage to about the centre of the clavicle.

Operation.

The patient being in the same position as for ligaturing the subclavian, a vertical incision is made 3 inches long, extending from about ½ an inch above the centre of the clavicle up the neck in the posterior triangle, a little way from the posterior edge of the sterno-mastoid.

The superficial parts and the deep fascia are freely divided. The edge of the scalenus anticus is defined, and by inserting the fingers deeply into the wound the cords of the plexus can be drawn upwards, cleared, and treated as may be desired.

Memoranda.

I. Retract or secure any large veins.

II. Do not wound the transverse cervical artery. It is generally seen and can be retracted.

CHAPTER III

LARYNGOTOMY, TRACHEOTOMY, AND THYROTOMY

LARYNX AND TRACHEA.

Anatomy (Fig. 114).

In the middle line of the neck from above downwards are the hyoid bone, thyroid cartilage, and cricoid cartilage; these are joined together respectively by the thyro-hyoid membrane and the crico-thyroid membrane. Below these is the trachea, covered about its second or third rings by the isthmus of the thyroid gland. In front the trachea is covered from before backwards by the anterior jugular veins, which are larger below near the chest, and communicate one with the other by transverse branches. Next the sterno-hyoid muscles, which are separated below, but about the middle join one another, and then again diverge at their attachment to the hyoid bone. Still deeper are the sterno-thyroid muscles, which are nearly joined in the middle line, but above diverge, to become attached to the thyroid cartilage. After these is the deep layer of the cervical fascia and the thyroid gland. At the lower part of the trachea there may be an artery, the thyroidea ima.

The trachea is further from the surface at the lower part of the neck than it is above at its junction with the larynx. Behind, the larynx and trachea rest on the œsophagus; on either side are the large vessels of the neck and the lateral lobes of the thyroid gland, together with the superior and inferior thyroid vessels and recurrent laryngeal nerves.

LARYNGOTOMY.

Operation (Fig. 115).

In this operation the air-passage is opened between the thyroid and cricoid cartilages by division of the crico-thyroid membrane.

The patient lies on his back with the head well extended; the back of the neck is supported by a pillow under the shoulders. The interval between the thyroid and cricoid cartilages is carefully made out. The surgeon stands on the right of the patient, and with the thumb and first finger of the left hand steadies the larynx. An incision about 1½ inches long is made in the middle line, commencing over the lower part of the thyroid cartilage, and continued downwards. With the handle of the knife the soft parts in the middle line may be separated down to the thyro-hyoid membrane, which is next opened by a horizontal incision just above the cricoid cartilage, and the tube inserted.

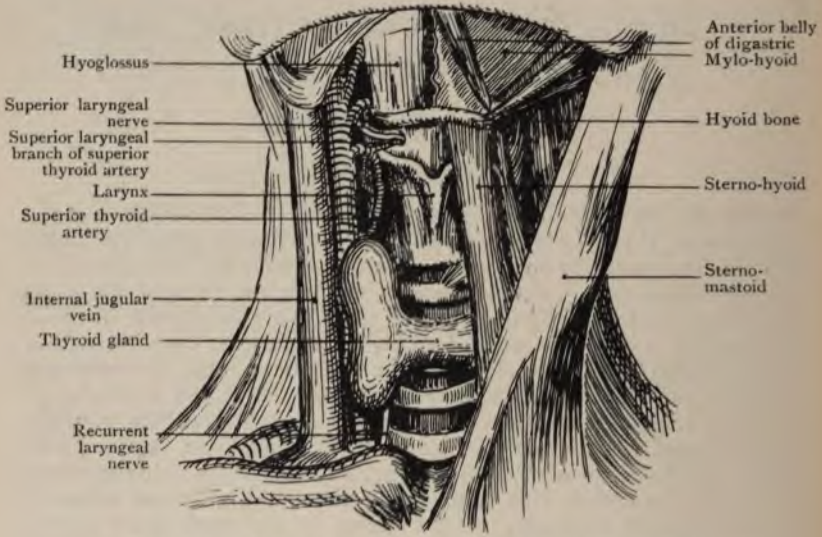

FIG. 114.—THE ANATOMY OF THE LARYNX AND TRACHEA.

Memoranda.

I. The operation cannot be done on children, as the parts are too small.

II. Remember to keep exactly in the middle line.

III. Divide the crico-thyroid membrane horizontally so as to avoid the crico-thyroid artery, which runs horizontally across the membrane.

IV. In introducing the tube, take care that it is not pushed down between the cricoid cartilage and the mucous membrane lining it; that is to say, when dividing the crico-thyroid membrane be sure to divide the mucous membrane also.

TRACHEOTOMY.

Operation (Fig. 115).

This operation may be performed in two situations—the *high* operation above, and the *low* operation below, the isthmus of the thyroid gland.

The position of the patient and the operator are the same as in laryngotomy.

The surgeon with his left hand steadies the trachea; an incision is made exactly in the middle line about 2 inches long, commencing just at the cricoid cartilage. The skin and fascia are divided, the sterno-hyoid and thyroid muscles exposed and separated. The fascia covering the trachea is reached and freely divided. The isthmus of the thyroid gland may be exposed, and should be pulled up or down, or even divided. The rings of the trachea are then exposed and steadied by a sharp hook, and divided from below upwards in the middle line. The tube is then inserted.

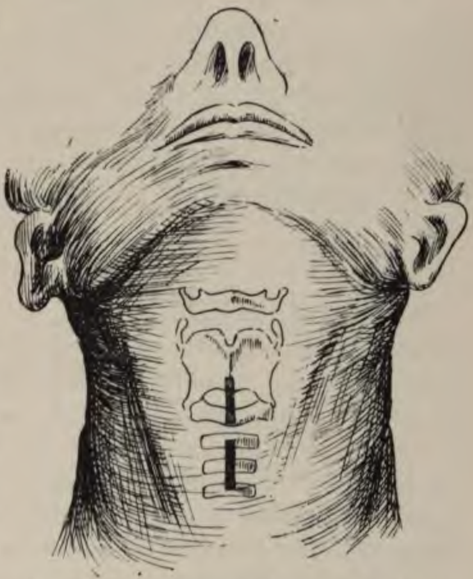

FIG. 115.—INCISIONS FOR LARYNGOTOMY AND TRACHEOTOMY.

Memoranda.

I. Have the neck completely extended, for thus the trachea is steadied and brought near to the surface.

II. Be most careful to keep exactly in the middle line and to divide freely or pull down the deep tracheal fascia.

III. Secure any artery divided, avoid the veins, and if possible secure them; but they may be left bleeding until the trachea is opened if there is any cyanosis or necessity to open the trachea rapidly. The venous bleeding will cease when the trachea is opened.

IV. Remember that no very great importance need be paid to the isthmus of the thyroid gland. If seen it must be pulled upwards or downwards. If, however, it is not readily seen, it may be divided without any great fear of hæmorrhage.

V. Remember that in the low operation the trachea is very much deeper. The veins crossing and near the trachea are large, and, moreover, in some cases the large vessels of the thorax encroach upon the lower part of the trachea in the neck.

THYROTOMY.

This consists in splitting the thyroid cartilage to remove growths or foreign bodies from the larynx. The anatomy and details are very similar to those of the operation above described. Laryngotomy or tracheotomy is first done, a Thompson's tracheotomy tube being introduced so as to stop any leaking of blood from the split thyroid into the trachea. A vertical incision is made over the centre of the thyroid cartilage, and the cartilage is carefully split up in the middle line. The thyro-hyoid and crico-thyroid membranes are divided if necessary. The lateral halves are retracted and the growth is removed.

Memoranda.

I. Always put a tube in the trachea below.

II. Avoid injuring the vocal cords if not diseased.

CHAPTER IV

ŒSOPHAGOTOMY — ŒSOPHAGOSTOMY — AND EXCISION OR REMOVAL OF PARTS

ŒSOPHAGUS.

Anatomy.

In the neck the œsophagus commences on a level with the cricoid cartilage. It starts in the middle line, and then bends slightly towards the left side of the neck. It returns again to the middle line in the chest, and then bends forwards to the left to enter the stomach. It is in relation behind with the vertebral column. In front are the trachea and thyroid gland, and on each side are the large vessels of the neck. The recurrent laryngeal nerves run up between the œsophagus and the trachea. The thoracic duct passes up behind the œsophagus for 1 inch above the clavicle, and then arches to the left to enter the left innominate vein.

Œsophagotomy.

This is performed to remove an impacted foreign body from the œsophagus.

The patient lies on the back with the head turned towards the right side. The operator standing on the left of the patient, an incision is made from a point on a level with the thyroid cartilage down to just above the sterno-clavicular articulation on the left side of the neck. The incision is vertical and in the direction of the carotid vessels, a little in front of the anterior border of the sterno-mastoid. The skin and fascia are divided and the anterior edge of the sterno-mastoid drawn aside. The omo-hyoid muscle is exposed and divided, or drawn downward.

The large vessels in their sheaths are then exposed and drawn outwards with the sterno-mastoid. The trachea and larynx are retracted inwards. The mouth is then opened, and a large bent probe passed from the mouth into the œsophagus. The point is pressed towards the left, thus making prominent the collapsed œsophagus. If the foreign body is impacted in the neck it can be felt, and the probe is unnecessary. The œsophagus is then seized with forceps, drawn more to the left, and opened by a vertical incision as much on the posterior aspect as possible. The foreign body is removed by forceps, the wound in the œsophagus sewn up with catgut, and the edges of the superficial wound united.

Memorandum.

Avoid injuring the recurrent laryngeal nerve, which runs up between the trachea and œsophagus; therefore open that organ on its posterior part as much as possible.

Œsophagostomy.

This operation consists in making a permanent opening in the œsophagus. It is performed in exactly the same way as the former operation, except that when the tube has been opened its edges are stitched to the edges of the skin cut at the lower part of the wound; the upper part is united as usual. It has sometimes been expedient at once to pass a soft tube and fix it in. This tends to prevent any union of the cut edges, and allows feeding into the stomach to be employed at once.

UPPER JAW.

Anatomy.

The upper jaw is united by its palate process with the bone of the opposite side, by its nasal process with the nasal bone, and above to the frontal bone. At the outer and upper part it is firmly joined to the malar bone. Behind it is united to the palate bone and the pterygoid process of the sphenoid.

The soft parts of the cheek are connected with it by small muscles, and the vessels supplying these are liable to bleed in the separation of the cheek from the bone. These vessels are the superior coronary, which is on the under surface of the upper lip; the infra-orbital as it issues from its foramen on the front of the bone; and the angular artery, or, as it may be termed, the terminal part of the facial artery, as it runs up by the side of the nose.

At the posterior upper part of the bone is the infra-orbital artery, or the terminal part of the internal maxillary artery, and running down behind the posterior part of the maxilla are the palatine arteries.

Removal of the Upper Jaw.

Operations.

1. Median incision (Fergusson).
2. The **V**-shaped incision (Langenbeck).
3. The cheek incision (Valpeau).

These names are given only to the skin incisions. The median is the best for many reasons, and will alone be described in full.

1. Fergusson's Method (Fig. 116).—The patient is placed on a table with his shoulders raised, and the operator stands on the right side. The upper incisor on the side to be operated upon is removed. Then the surgeon, having grasped one side of the upper lip (and the assistant the other), divides it in the middle line, and continues the incision round the ala of the nose, and so up by the side of the nose to the inner canthus of the eye. The coronary arteries, and any part of the angular artery which may be divided, are secured. From the end of the incision at the inner canthus another is made along the lower margin of the orbit to the malar bone.

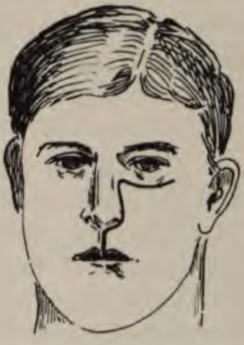

FIG. 116. — FERGUSSON'S INCISION FOR THE REMOVAL OF THE UPPER JAW.

The flap so figured is reflected outwards, and the soft parts are freed from the front of the upper jaw, the knife being kept close to it or to the surface of the tumour. The vessels in this flap are then secured. The ala of the nose is freed, and a pair of strong cutting bone forceps are then used to divide the nasal attachment, one blade being inserted into the nose, and the other outside. Next, attention is turned to the orbit, and the periosteum is freed by an elevator from the upper surface of the bone. The union of the malar bone with the superior maxilla is sawn into, and the division completed with strong cutting bone forceps. The division extends into the spheno-maxillary fissure. A saw is inserted along the floor of the nostril, and the palate attachment sawn through or divided by the cutting forceps. All the bony attachments being now free, the soft palate is divided at its attachment to the hard. The jaw is then grasped with a strong pair of lion forceps, and the remaining thin bony attachments severed by twisting the bone out. The cavity so formed is carefully scraped out if any growth remains, the vessels secured, and the flap is put back and secured in place. The lip line is united carefully with sutures or hare-lip pins. When feasible, the orbital plate should be left; this is effected by sawing from the nose across the anterior surface of the jaw just below the orbital plate to the division between the malar bone and the superior maxilla.

Memoranda.

I. Clip all the vessels as divided, only do not ligature them until the jaw is removed.

II. The best procedure is to start by performing tracheotomy and ligature of the external carotid; a sponge put in the pharynx prevents blood getting into the trachea, and ligaturing the external carotid makes the operation almost bloodless.

III. Remember to divide freely all the firm bony attachments while dealing with each respective point.

IV. Divide the hard palate last, as there is frequently rather sharp bleeding from the palatine arteries.

V. Do not forget to divide the soft palate before attempting to wrench out the jaw.

VI. Hæmorrhage while making the face-flap can be controlled by pressure on the facial artery. This is not necessary if the external carotid has been ligatured.

2. Langenbeck's Incision (Fig. 117).—This is **V**-shaped, and commences at the lower part of the nasal bone. It is then carried downwards to the junction of the cheek with the upper lip, and thence upwards and outwards to the malar bone. The flap is convex downwards.

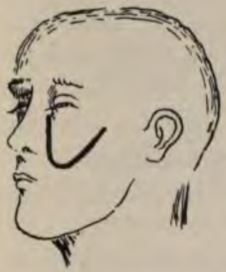

FIG. 117.—LANGENBECK'S INCISION FOR REMOVAL OF THE UPPER JAW.

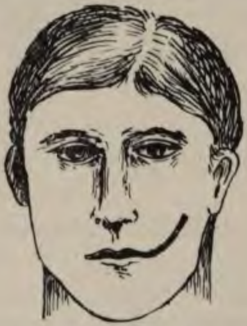

FIG. 118.—VALPEAU'S INCISION FOR REMOVAL OF THE UPPER JAW.

3. Valpeau's Incision (Fig. 118).—This is commenced at the angle of the mouth, and is carried through the cheek to the middle of the malar bone.

LOWER JAW.

Anatomy (Fig. 119).

The two bony parts of importance are the coronoid process and the condyle. The coronoid process has the temporal muscle inserted into it, and is covered in by the malar bone. The external condyle is behind, resting in the glenoid cavity, and having very important structures in relation with it.

The inferior dental nerve enters the foramen on the inner side of the vertical ramus of the jaw. There are also important vessels in very near relation—viz., the internal maxillary artery, running close to the upper and inner side of the vertical ramus, and the external carotid artery behind the condyle.

The nerves near the site of operation are the facial, winding round below the condyle to come on to the cheek; the lingual nerve, on the inner side; and the auriculo-temporal behind.

The cheek is connected with the jaw by the buccal mucous membrane. The floor of the mouth is chiefly formed by the mylohyoid muscle, which is attached to the jaw, and in front are the slight attachments of the hyo-glossus and genio-hyo-glossus muscles.

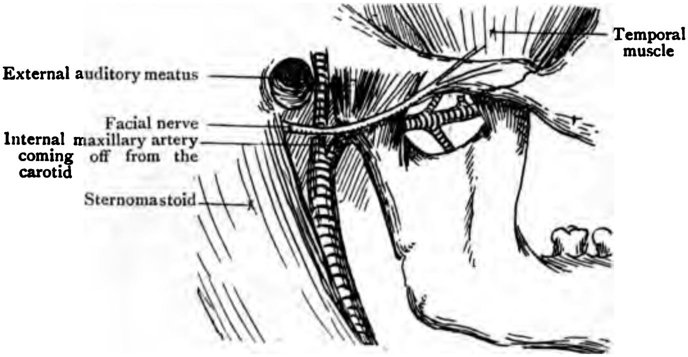

FIG. 119.—DIAGRAM TO SHOW THE IMPORTANT RELATIONS OF THE CONDYLE OF THE LOWER JAW.

Removal of the Lower Jaw.

Operation (Fig. 120).

The patient's shoulders are supported, the operator stands as a rule on the side of the patient on which the jaw is to be removed. An incision is made in the middle line through the lower lip down to the front of the chin. It is continued along the lower edge of the jaw to the angle, and thence up the posterior border of the vertical ramus so as to finish at a point on a level with the lobe of the ear. The flap so marked out is turned upwards, the buccal mucous membrane being separated from the jaw at its attachment to the alveolus. The muscles, including the masseter, are separated close to the bone if they are not involved in the growth. An incisor tooth is then extracted, and the jaw sawn through in the middle line. The bone being divided, the half to be removed is well drawn outwards, and the attachment of the muscles to the inner side freely divided, the knife during the whole time being kept close to the bone. As soon as the internal pterygoid is severed from the inner side of the angle of the jaw, attention is turned to the inferior dental vessels and nerve; these are divided and the artery secured. This stage of the operation being completed, the jaw is firmly depressed, and the attachment of the temporal muscle to the coronoid process divided. If this is not possible, the coronoid process is cut through by cutting bone forceps and afterwards dissected out. With the jaw still strongly depressed, the condyle is brought into view. The capsular ligament in front is divided, and the remaining structures torn through or very carefully cut. The vessels are then secured, and the skin flap is brought down and its edges united, a couple of hare-lip pins or sutures being used to unite the edge of the lip in front.

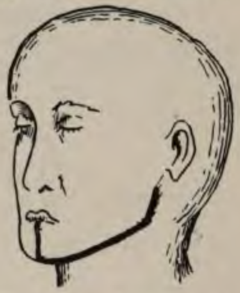

FIG. 120.—INCISION FOR REMOVAL OF THE LOWER JAW.

Memoranda.

I. Do not carry the vertical posterior incision higher than the lobe of the ear, for fear of wounding the facial nerve.

II. When the jaw has to be sawn through exactly in the middle line, or, rather, towards the sound side, pass a ligature through the tongue to prevent it falling back over the larynx, as most of the muscles holding it in front are divided.

III. When freeing the condyle of the jaw, keep the knife as close as possible to the bone, for fear of wounding the large vessels near it, especially the internal maxillary artery, which runs very close on its inner side—viz., between it and the internal lateral ligament.

The jaw may be removed in pieces—for instance, the horizontal ramus alone. These operations are only minor forms of the above-described method.

Excision of the Condyle of the Jaw.

Operation (Fig. 121).

A vertical incision is made over the temporo-maxillary joint, commencing at the zygoma, and ending about an inch lower down. Another incision is made along the lower margin of the zygoma to meet the first. The flap so formed is turned forwards. The exposed fibres of the masseter are divided and turned down. The capsule of the joint is next opened. The neck of the condyle is sawn through with a keyhole saw, the line of the saw-cut being obliquely downwards and backwards; the condyle is then wrenched from its attachments, a few touches of the knife being sufficient to free it.

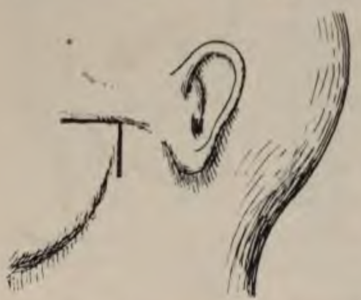

FIG. 121.—INCISION FOR EXCISION OF THE CONDYLE OF THE JAW.

THE TONGUE.

Anatomy (Fig. 122).

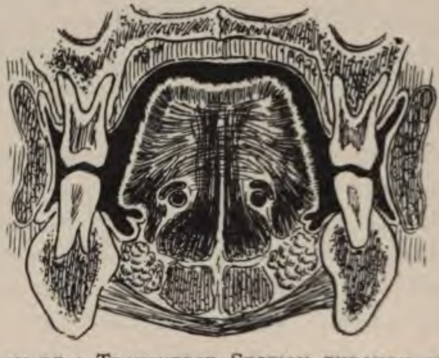

FIG. 122.—DIAGRAM OF A TRANSVERSE SECTION THROUGH THE BASE OF THE TONGUE AND JAW, SHOWING THE POSITION OF THE MAIN VESSELS.

The tongue is connected with the lower jaw by the mucous membrane passing from it over the floor of the mouth to become attached to the inner side of the lower jaw. Behind it is attached to the epiglottis by the glosso-epiglottic folds, and to the hyoid bone by the genio-hyo-glossus and hyo-glossus muscles.

Another important attachment is the anterior pillars of the fauces formed by the stylo-glossus and the palato-glossus muscles.

The important vessels running into the tongue on its under surface are the lingual and some small branches from the ascending pharyngeal and tonsillar arteries; the latter are quite small, and may be almost disregarded.

Removal of the Tongue.

Operations.

1. Whitehead's.
2. Syme's.
3. Kocker's.
4. Splitting the cheek.

In all these operations, if the surgeon wishes, a preliminary laryngotomy may be done, and the pharynx plugged by an aseptic sponge.

1. Whitehead's Operation (Fig. 123).—The operator stands on the right of the patient, who is brought well to the side of the table. With the shoulders raised and head well supported, a gag is inserted on the left side of the mouth and the jaws opened. The tongue is transfixed about an inch from its tip by two ligatures, one for each half. The surgeon with a knife divides the mucous membrane along the centre of the tongue exactly in the middle, and with his fingers splits the tongue in two (right back), so as to be well behind the growth. If only one-half is diseased, that is alone removed; if the whole tongue, first one half and then the other is removed in the following manner: The side most diseased is drawn out of the mouth, and with scissors the mucous membrane attaching it to the jaw is divided. The anterior pillar of the fauces is next detached. Then the muscles fixing it to the floor of the mouth are divided with scissors, which are carefully held well away from the tongue itself. After this a long pair of clip forceps is applied well behind the growth to the back of the tongue, inserted deeply into the anterior surface of the root of the tongue, and the organ is cut away on the distal side of the forceps. The portion of tongue containing the vessels held by the clip is firmly ligatured and the forceps removed. If the other half of the tongue is diseased, it is removed in a similar manner.

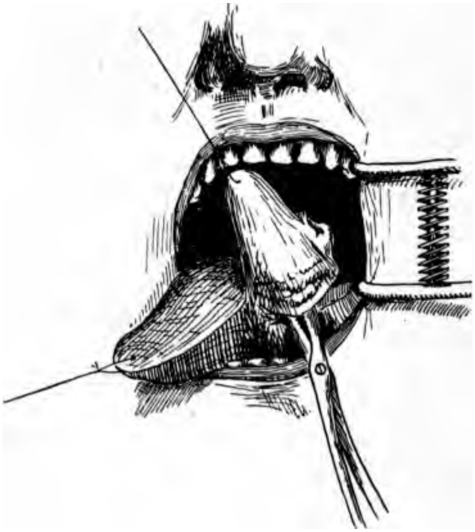

FIG. 123.—WHITEHEAD'S OPERATION FOR REMOVAL OF THE TONGUE.

Memoranda.

I. Always split the tongue, even if the entire organ has to be removed, as the lingual arteries can then be separately dealt with.

II. Do not forget to divide the anterior pillar of the fauces, as this facilitates the drawing forward of the tongue.

III. Apply a long and strong clip to the anterior or under surface of the base of the tongue before removing it, as this controls the stump, and at the same time often secures the lingual vessels.

IV. If only the anterior half of the tongue is removed, do not forget to leave a ligature through the remaining posterior half, as there is a tendency for it to fall back over the glottis, after all the anterior attachments have been divided.

2. Syme's Operation.—This consists in dividing the symphysis of the jaw, and then removing the organ as above described, using the scissors or the écraseur to remove the tongue. After the removal the two pieces of the jaw are wired together.

3. Kocker's Operation (Fig. 124).—An incision is made from the symphysis in the middle line to the hyoid bone, and carried backwards from the hyoid bone to the anterior edge of the sterno-mastoid about the angle of the jaw, and then up to the lobe of the ear. This flap is turned upwards. The lingual artery is secured, and the mylo-hyoid muscle divided; thus the floor of the mouth is opened, and the tongue brought out of the incision and removed.

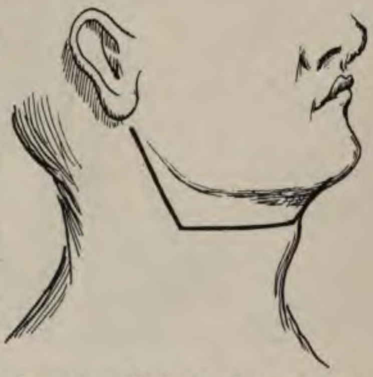

FIG. 124.—KOCKER'S INCISION FOR REMOVAL OF THE TONGUE.

4. Splitting the Cheek.—When the disease is very far back, and perhaps involving the anterior pillar of the fauces, the cheek may be split from the angle of the mouth backwards to the masseter muscle, and the tongue removed.

THE LARYNX.

Anatomy (Fig. 125).

The larynx is chiefly made up of the thyroid and cricoid cartilages. Above it is attached to the hyoid bone by the thyro-hyoid ligaments, and below it is continuous with the trachea.

It is covered in front by the sterno-hyoid and omo-hyoid muscles. The lateral lobes of the thyroid gland overlap it, and attached to it are the sterno-thyroid and the thyro-hyoid muscles in front. Behind are the inferior constrictor of the pharynx and the stylo-pharyngeus muscle. It rests on the pharynx, and is intimately connected with it, and lower down with the œsophagus. The superior thyroid arteries enter from above, the inferior thyroid vessels from below. Outside and in close relation with it are the large vessels of the neck and the pneumogastric nerves.

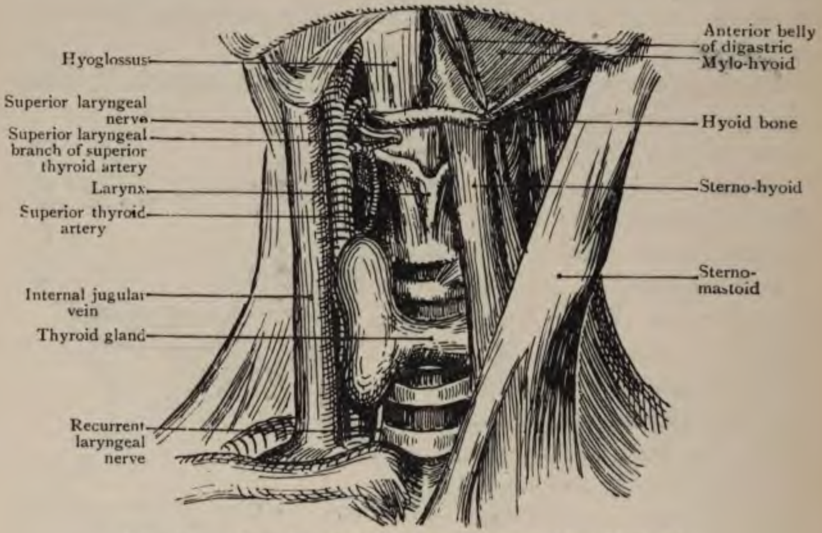

FIG. 125.—THE ANATOMY OF THE LARYNX AND TRACHEA.

Removal of the Larynx.

Operations (Fig. 126).

1. Complete removal.
2. Removal of one-half.

1. Complete Removal.—A low tracheotomy should be done at least ten days prior to the excision, in order that the patient may become used to the tube.

The patient having had a tampon tracheotomy tube introduced so as to prevent any blood from running into the lungs, is thoroughly anæsthetized through the tube.

The surgeon stands on the right side of the patient, whose shoulders are raised and head well extended. A vertical incision is made from the hyoid bone to the second or third rings of the trachea. The incision is carried down to the thyroid and cricoid cartilages. From the upper end of this incision a transverse one is then made, extending on either side out to the sterno-mastoid. The flaps of skin are reflected; the superior thyroid arteries are secured about the upper border of the thyroid cartilage, just at the posterior border of the thyro-hyoid muscle. The inferior thyroid vessels are discovered entering the lower part of the larynx, and in like manner are secured. Next, with an elevator the muscles are cleared, first from one side of the thyroid cartilage and then from the other.

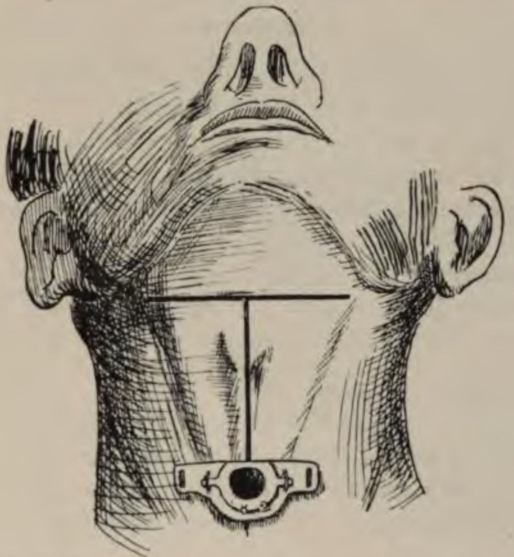

FIG. 126.—THE INCISION FOR REMOVAL OF THE LARYNX, SHOWING THE TRACHEOTOMY-TUBE IN PLACE.

When this is done the larynx is seized and drawn to one side, and at the same time elevated, and the attachment of the inferior constrictor carefully cleared away. During this procedure the soft parts are thoroughly retracted outwards; the larynx is next detached by cutting through the trachea between the cricoid cartilage and the first ring, or between two of the tracheal rings. The lower end of the trachea is secured by sutures and later on united to the skin. The larynx is next most carefully separated from the œsophagus and the pharynx. Lastly, the thyro-hyoid ligaments are divided. In this manner the larynx is removed. The divided end of the trachea is sutured to the skin and the skin wound closed.

Memoranda.

I. Do not buttonhole the œsophagus or pharynx when separating them from the back of the larynx.

II. If there is any uncertainty as to whether it is necessary to remove the entire larynx, split the larynx with scissors.

III. Separate the muscular attachments to the larynx with a raspatory.

IV. Remember to pass ligatures through the end of the trachea before it is entirely separated from the larynx, for if the division is far down, the trachea may slip out of sight.

2. Removal of One Half.—This is performed in an exactly similar manner; the thyroid and cricoid cartilages are split after the lateral parts have been cleared. The same important points are to be borne in mind, and in many of these partial excisions the cricoid cartilage need not be removed.

THYROID GLAND.

Anatomy (Fig. 125).

The gland rests on the larynx and trachea, the two lateral lobes being united by an isthmus, which rests on the trachea about the second or third rings. On each side of the lobes, and even under them, are the large vessels of the neck—namely, the carotid and the internal jugular. The superior thyroid vessels enter the lobes from above, the inferior thyroid vessels from below. Close to the inferior thyroid vessels, and under each lobe, between it and the trachea, are the recurrent laryngeal nerves. Covering the lateral lobes of the gland in front are the anterior jugular veins, the sterno-hyoid, sterno-thyroid, and omo-hyoid muscles. More superficially is the platysma, and on the outer side sometimes the sterno-mastoid muscles

Thyroidectomy.

Operation (Fig. 127).

A description is given only of the operation for removal of one lobe, as that alone appears justifiable.

The patient's shoulders are raised; the surgeon stands on the right side. A vertical incision is made over the most prominent part of the tumour down to the sternum, and is supplemented by another incision carried out from this point along the upper border of the clavicle. This flap is dissected up. Any large veins are avoided or clipped and secured if they are in the way. The deep fascia is exposed after division of the platysma; it is divided and the gland exposed. The sterno-hyoid and sterno-thyroid muscles are then seen, separated, and pushed aside, or divided and turned upwards and downwards; the sterno-mastoid is retracted or divided. Attention is turned to the upper part of the tumour, where the superior thyroid vessels enter it. These are secured in two places and divided. Next the inferior thyroid arteries are sought for, and tied close to the tumour. The tumour, which is now only attached by the isthmus, is turned to the opposite side, and the isthmus ligatured and divided.

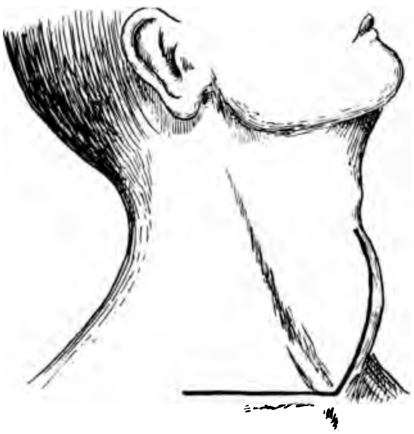

FIG. 127.—THE INCISION FOR THE REMOVAL OF THE RIGHT LOBE OF THE THYROID GLAND.

Memoranda.

I. The capsule of the tumour must on no account be opened. If it is opened the bleeding is most severe.

II. Do not wound the large veins when separating the growth. If they are in the way they should be secured and divided.

III. Remember that the internal jugular vein is sometimes displaced, and is located upon the front or side of the tumour.

IV. If the isthmus is very broad secure it in pieces, or tear through the cellular tissue and secure the vessels as they are exposed.

V. Great care must be taken not to injure the recurrent laryngeal nerve, or to include it in the ligature when securing the inferior thyroid artery. Ligature this artery quite close to the thyroid gland.

THE TONSIL.

Anatomy.

It lies between the anterior and posterior pillars of the fauces, and is in relation outside with the superior constrictor of the pharynx. It is opposite the angle of the lower jaw. The internal carotid artery is some way from and behind it.

Excision of the Tonsil.

Operations.

1. Removal from mouth.
2. Removal by an external incision (Raymond Johnson).

These operations are only employed in removing the tonsil for malignant disease.

1. Removal from the Mouth.—The mouth is opened by a gag, and the cheek on the same side split right back to the masseter muscle. The tongue is drawn out of the mouth. With the finger and a blunt director the surgeon enucleates the tonsil and any other diseased tissues in the neighbourhood.

2. Removal by an External Incision (Raymond Johnson) (Fig. 128).—An incision is made from about the lobe of the ear downwards and forwards to the hyoid bone. The superficial structures are divided and the veins secured. The digastric and stylo-hyoid muscles are divided and the large vessels of the neck exposed. The internal and external carotids are isolated and ligatured if necessary. The finger is then inserted into the mouth and the tonsil pushed outwards. With a blunt director the stylo-glossus, stylo-pharyngeus, and superior constrictor and tonsil, are separated, freed, and removed.

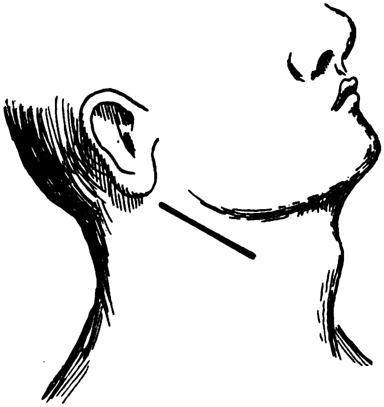

FIG. 128.—RAYMOND JOHNSON'S INCISION FOR REMOVAL OF THE TONSIL.

CHAPTER V

PLASTIC OPERATIONS

HARE-LIP AND CLEFT PALATE.

Anatomy.

THE anatomy of hare-lip and cleft palate is thus shortly described by Treves: 'The buccal cavity when first formed in the fœtus exists as a wide cleft in the face, bounded above by the fronto-nasal process, at the sides by the superior maxillary processes, and below by the first visceral arch, around which the lower jaw is formed. The nasal and buccal cavities are one. The separation of the mouth, strictly so called, from the nasal fossæ is effected by the development of the palate, the two sides of which, advancing inwards, meet and coalesce with each other and with the septum, which descends from above in the middle line. In this way the hard and soft palate are formed and the upper lip completed. It will be understood that hare-lip and cleft palate depend simply upon imperfect closure of the fœtal gap between the nasal and buccal cavities.'

Single Hare-lip.

Operations.

1. Usual operation.
2. Clémot's operation.
3. Nélaton's operation.
4. Mirault's operation.
5. Giralde's operation.

1. The Usual Method (Fig. 129) of performing this operation is as follows: The child is enveloped in a blanket so as to confine its arms to its sides; the head is steadied by an assistant. The attachment of the upper lip is freely separated by scissors from the jaw beneath by cutting through the mucous membrane. The edges of the lip are now pared; the end of each side of the cleft is held with tenaculum forceps, so as to put the lip on the stretch while the paring is being done, beginning at the upper angle of the cleft and continuing well down to the free edge. The cheeks are then pressed together and the hare-lip pins passed, and the edge of the lip carefully united with a fine suture.

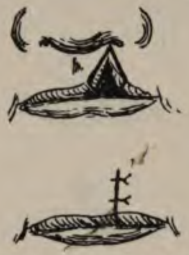

FIG. 129. — OPERATION FOR SINGLE HARE-LIP.

Memoranda.

I. Thoroughly free the lip from its attachment to the bone surface beneath by dividing the mucous membrane.

II. Freely pare the edges of the cleft; that is to say, do not only cut away the red mucous membrane edge, but cut well into the skin.

III. Remember that the hæmorrhage can be controlled by the assistant pressing on the facial arteries on each side of the jaw while he holds the head steady.

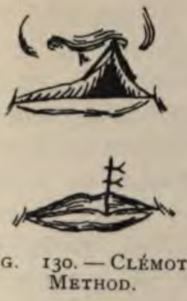

FIG. 130. — CLÉMOT'S METHOD.

2. Clémot's Method (Fig. 130).— The edges are pared down to, but not beyond, the red margin of the lips; the flaps thus freed are turned downwards and kept out of the way, while the upper part is brought together. Any excess of the everted flaps that is projecting below the lip line is cut off; the edges of the lip are then carefully united with fine sutures.

3. Nélaton's Method (Fig. 131).—Around the upper angle of the cleft a **V**-shaped incision is made, the limbs of the **V** being downwards. This is opened so as to make a lozenge-shaped wound; and the raw surfaces are then united.

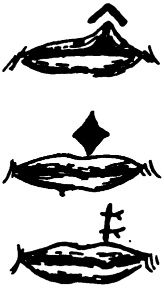
FIG. 131.—NÉLATON'S METHOD.

4. Mirault's Method (Fig. 132).—This is used when the divergence is great and the sides of the cleft unequal. On one side of the cleft an incision is made downwards from the apex of the cleft as far as the lip margin, but not through it; that is to say, it acts as a flap to turn down. The other edge of the lip is then freely pared from its apex right through, leaving no flap. The little flap on the one side is turned down, brought across, and united to the lip margin, so forming the free margin of the lip.

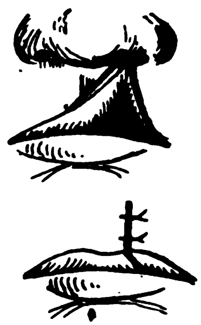
FIG. 132.—MIRAULT'S METHOD.

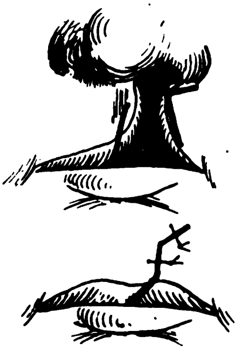
FIG. 133.—GIRALDE'S METHOD.

5. Giralde's Method (Fig. 133).—This is suitable when the cleft extends badly into the nose and the edges of the cleft are very irregular. From the more vertical side of the cleft a flap is cut, as in Mirault's method, attached at the free edge and loose above. From the upper end of this incision another is carried outwards just below the border of the nasal orifice. From the long or oblique side of the cleft another flap is cut with its *base upwards* and its free end downwards. This flap is turned upwards, and its apex fixed to the outer end of the transverse cut just below the nasal orifice, thus making an edge to the lower part of the nasal orifice. The flap cut from the more vertical part of the cleft, and with its base downwards, is turned down, and makes the free margin of the lip. The parts are then brought together with hare-lip pins and sutures.

Double Hare-lip.

Operation (Fig. 134).

In operations for this condition the intermaxillary bone has to be dealt with. When prominent, it is either broken or pushed back into its place; when very prominent, in some cases it may be necessary to cut a **V**-shaped piece of bone out of the nasal septum behind to allow it to be depressed.

The lip part of the operation is much the same as that already described.

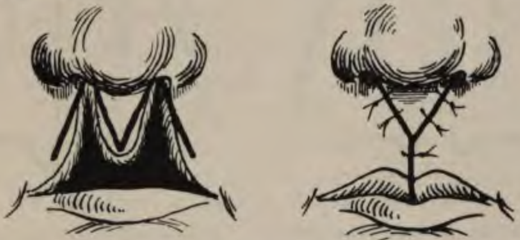

FIG. 134.—OPERATION FOR DOUBLE HARE-LIP.

The skin over the premaxillary bone is well freed from its deep attachments and its edges pared. The margin of the other parts of the cleft are pared and flaps made if required. In most cases, however, this is unnecessary.

CLEFT PALATE.

Operations.

1. Thomas Smith's.
2. Fergusson's.
3. Davies-Colley's.

1. Thomas Smith's Method (Fig. 135).—The patient lies on his back, the arms secured by a band under the table, and the head well supported on a sand-bag. An assistant steadies the head, and at the same time holds the gag (Smith's) in position. The tip of one side of the uvula is seized, the soft palate held tense, and the edges pared, the paring being continued from the tip of the uvula to the anterior part of the hard palate. The other half of the cleft is in like manner treated. This done, a small cut is made over the hard palate down to the bone midway between the teeth and the margin of the cleft, and midway between the anterior and posterior parts of the hard palate. Through this incision a curved raspatory is passed between the periosteum and the bone, and worked inwards towards the middle line, where it appears at the cleft. By the raspatory the attachment of the muco-periosteum is freely separated from the bone all over the hard palate; the same procedure is carried out on the other side. It will then be found that at the back part of the hard palate—that is to say, where it joins the soft palate—the muco-periosteum is firmly attached by fascia to the bone, and by mucous membrane to the mucous membrane of the nose. In order to separate it here a curved pair of scissors are used,

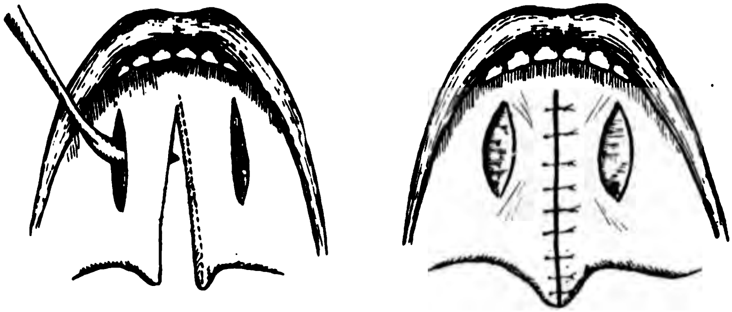

FIG. 135.—THOMAS SMITH'S OPERATION FOR CLEFT PALATE.

The left-hand figure shows the method of separating the muco-periosteal flap by means of a raspatory, and the dotted line shows the line for paring the cleft. The right-hand figure shows the cleft closed with sutures and the tension incisions gaping.

one blade being between the part separated from the bone, and the other above the soft palate. The division of these structures on both sides should free the periosteum and soft palate from the bone, and allow the separated parts to fall more forwards. The sutures are now passed, using silver for the hard, and some soft suture, such as horsehair, for the soft palate. The silver sutures are best inserted by Smith's needle, which is passed from the lower surface of one flap to its upper surface, then across the gap, and from the upper surface of the other flap to its under surface. The end of the wire is then secured and the needle withdrawn. As many of these sutures are inserted as may be deemed necessary; they need not be twisted up until those in the soft palate are passed. The soft palate sutures are best inserted by a rectangular needle. Lastly, the wire sutures are twisted up and the soft ones tied.

If there is any tension on the flaps, this may be relieved by prolonging backwards and forwards the small incision made for the introduction of the raspatory. The same lateral incision, if necessary to relieve tension in the soft palate, may be prolonged backwards into the soft palate, being kept well inside the hamular process so as to avoid the posterior palatine vessels.

Memoranda.

I. Pare thoroughly the edges of the cleft.

II. Do not place the sutures too near to the edges of the flaps, for fear of their cutting through.

III. Always relieve tension by lateral incisions.

IV. Remember to have many varieties of needles and various shapes and sizes of raspatories.

2. Fergusson's Method.—In this operation the edges of the cleft are pared; a chisel is then inserted about ¼ inch from the margin of the gap on each side, the bone divided into the nose, and each half levered together in the middle. Sutures are inserted to bring together the pared edges.

3. Davies-Colley's Flap Operation (Fig. 136).—The position of the patient, etc., is the same as that described in the first operation. A flap (A) is cut with its base towards the cleft, and raised with the muco-periosteum by a raspatory, so that it is only attached along the edge of the cleft. Another flap (B) is cut with its base backwards on the opposite side of the cleft; this is raised with the muco-periosteum. In cutting this flap, the inner incision should be carried backwards to the tip of the uvula, so as to pare the edge of the cleft in the soft palate. The small piece of mucous membrane left between this last flap and the edge of the cleft in the hard palate (C) is now raised, so that it remains attached along the edge of the cleft. Next the flap (A) is turned across the cleft, so that its mucous surface looks into the nasal cavity; its free edge is then stitched to the free edge of the small flap (C), which has been similarly turned across the gap. Then the long flap (B) is detached and taken across the gap, and its free end stitched into the space left by the detachment of the flap (A), so that the flap (A) now has its mucous surface towards the nose, while the flap (B) has its mucous surface towards the mouth as before, and the raw surfaces of both are in contact. Lastly, the cleft in the soft palate is closed after the other edge has been pared.

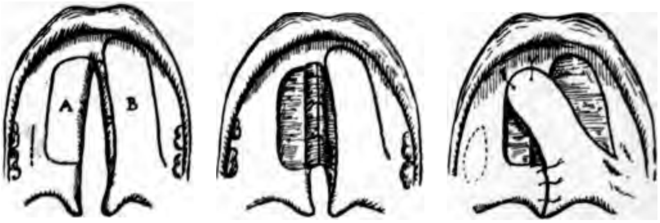

FIG. 136.

Memoranda.

I. The long flap B must be made as large as possible, and should contain the posterior-palatine artery in it.

II. An incision is sometimes necessary on the outer side of the flap A (see dotted line in Fig. 136) to relieve tension on the base of the big flap.

III. Care should be taken to retain the nutrition of the flaps as much as possible.

TENOTOMY.

Sterno-Mastoid.

Anatomy.

The sterno-mastoid has two heads, sternal and clavicular, attached as their names indicate. The anterior jugular vein is just behind it at its insertion into the clavicle. The external jugular vein is close to the outer border.

Operation.

Division by the Subcutaneous and Open Method.—The shoulders are raised, and the surgeon stands on the affected side. A vertical incision is made about the inner border of the sternal attachment of the muscle with a sharp-pointed tenotome. The fascia is divided and the tendon reached. A blunt-pointed tenotome is then passed down to the tendon and horizontally along its back part, the knife being kept flat. The edge of the knife is then turned to the tendon, which is divided. In dealing with the clavicular portion, the sharp tenotome is introduced about the inner edge of the clavicular attachment, and as soon as the skin and fascia are divided the blunt-pointed tenotome is introduced, and kept close to the posterior edge of the muscle and as near to the upper border of the clavicle as possible.

In these aseptic days the tendon can safely be divided by the open method. A position is chosen about the lower part of the muscle, so that the skin scar will not be very conspicuous. The tendon is thoroughly exposed and divided on a director passed under it; by this method it can be absolutely made certain that all the tendon has been divided.

CHAPTER VI

OPERATIONS ON THE HEAD AND BRAIN

THE CRANIUM.

Anatomy (Fig. 137).

The anterior fontanel, or the junction of the sagittal and coronal sutures, is marked out by a line drawn vertically upwards from the external auditory meatus.

The posterior fontanel is represented by the point of junction of the sagittal suture with the lambdoid, and is about 2¾ inches above the external occipital protuberance.

The coronal suture may be marked out by a line drawn from the position of the anterior fontanel to the middle of the zygoma.

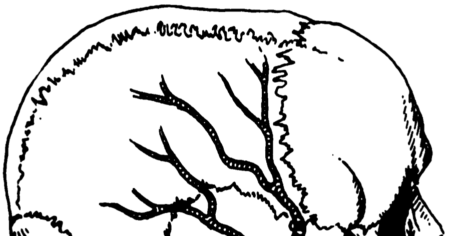

FIG. 137.—SIDE VIEW OF THE SKULL TO SHOW THE POSITION OF THE MIDDLE MENINGEAL ARTERY AND ITS BRANCHES IN THEIR RELATION TO THE SURFACE.

The lambdoid suture is denoted by the upper two-thirds of a line drawn from the posterior fontanel to the apex of the mastoid process.

The longitudinal sinus is shown by a line drawn from the root of the nose over the vertex in the middle line to the occipital protuberance, and forming it is the falx cerebri, which dips down between the two hemispheres of the cerebrum.

The lateral sinus is indicated roughly by a line drawn from the occipital protuberance to the front border of the mastoid process.

It is formed by the attached edge of the tentorium cerebelli, which supports the back part of the cerebrum.

The occipital sinus is marked out by a line drawn downwards in the middle line from the occipital protuberance to the edge of the foramen magnum. It is in the attached edge of the falx cerebelli, which separates the lobes of the cerebellum.

The middle meningeal artery is most easily reached at a spot 1½ inches behind and ½ inch above the external angular process of the frontal bone.

Levels of the Brain.—The lower level of the brain in front is shown by a line drawn across the forehead just above the eyebrows. At the side of the head the lower level is fairly represented by a line drawn from a point ½ an inch above the external angular process of the frontal bone to the upper part of the external auditory meatus. A line then drawn from this spot to the occipital protuberance indicates the lower level of the cerebral lobes, the part below being occupied by the cerebellum.

Before treating of the operation of trephining, it may be well to give the methods of arresting bleeding from sinuses, vessels, or the brain substance.

Hæmorrhage from the Lateral Sinus.—This can be controlled by:

1. Moderate pressure made by finger, sponge, or aseptic gauze.
2. Putting on clip forceps till the operation is completed, and then packing or ligaturing if the hæmorrhage has not stopped.
3. Stitching up the rent or wound in the sinus with two or three fine catgut sutures.
4. In cases where all these methods fail, the skin flap may be sewn down and pressure applied outside.

Hæmorrhage from the Middle Meningeal Artery or any other Large Artery.—This may be checked by:

1. Pressure made by the finger, artery forceps, or sponge.
2. If the artery is in the bone, by plugging the orifice with wax or a plug of wood, or by pressing with strong bone forceps the outer and inner tables of the skull together.
3. Cutting away some more of the bone, and thus freely exposing the vessel.
4. By passing a suture beneath the vessel with a curved needle.

5. By ligature of the external carotid artery. This is seldom necessary.

Hæmorrhage from the Brain may be arrested by—

1. Securing any large vessels.
2. Sponge pressure and hot water.

In trephining, if possible, avoid the position of the sinuses or large vessels; but, at the same time, their position with regard to the seat of injury or disease must not deter the surgeon from operating. The bleeding can easily be controlled by one of the above methods.

TREPHINING THE SKULL.

Operations.

For fracture.
For mastoid disease and thrombosis of lateral sinus and abscess connected with ear disease.
For cerebral tumour.
For cerebral abscess.
For frontal sinus disease.

Trephining for Fracture.

Operation (Fig. 138).

The head is shaved, thoroughly cleaned, and well supported on a sand-pillow. A flap is turned up so as to expose the seat of injury. This flap is made by cutting down on to the bone, and is reflected together with the periosteum. Any vessels in the flap are secured with clip forceps.

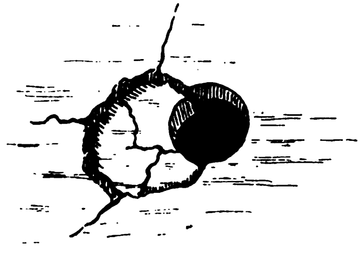

FIG. 138.—METHOD OF TREPHINING FOR DEPRESSED FRACTURE.

The seat of fracture is next investigated, and, if possible, the fragments are elevated with an elevator or pulled away with bone forceps. If this cannot be done a trephine is applied near to, or even partially over, the fractured pieces. The pin of the trephine is protruded and the rotatory movements started. As soon as the edges of the trephine have a good grip on the skull the central pin is withdrawn and the rotatory movements continued. The depth of the circular cut so made is from time to time tested by a needle to see that the depth of the cut is equal all round, and, moreover, to let the surgeon know when the bone is divided. As soon as it is cut through sufficiently, an elevator may be inserted into the trephine cut and the circle of bone removed. Through the hole so made the fragments of bone may be elevated and taken out. If needful, another crown of bone may be removed, and the opening united to the previous one by sawing through the intervening wedge of bone, or cutting it away with Hoffmann's bone forceps, and so giving more room to work in.

The dura mater, if damaged, should then be thoroughly cleaned and brought together with sutures, and the skin flap turned down over the aperture and sutured.

Memoranda.

I. Always cut a semilunar skin flap, as this may prevent hernia cerebri occurring later on.

II. In trephining, always consider it is the thinnest skull possible that is being operated upon. Remember that the skull may be thinner at one part of the crown than at another, so that one part may be divided before the other. Therefore, constantly explore the depth of the bone-cut with a needle, so as to know at once when the bone is divided.

III. Be careful of the brain and dura mater, but do not be afraid of operating boldly but carefully.

Trephining for Middle Meningeal Hæmorrhage.

Operation.

A semilunar flap, with its free edge upward, is turned down so as to expose the spot 1½ inches behind and ½ inch above the external angular process of the frontal bone. This is done on the side of the injury, or on the *opposite* side to the paralysis. In dividing the skin there is sharp bleeding, which must be controlled with clip forceps. The bone being exposed, a fracture is looked for, and may be discovered by blood oozing from it. If the fracture is found, a large trephine is applied over it; if there is no fracture, it is applied over the position of the vessel. The bone being removed, the meningeal artery will be exposed; if wounded, it must be dealt with as has been described.

Should it be necessary to trephine over the posterior branch owing to the main trunk being found uninjured, it may be reached by taking out another crown of bone at the junction of a horizontal line drawn from the upper margin of the orbit to meet one drawn vertically upwards from immediately behind the mastoid process, or by enlarging the original opening backwards with Hoffmann's bone forceps.

Memorandum.

Remember to take away sufficient bone, so as to allow free access to the clot and to the bleeding vessel.

Middle Ear and Mastoid Cells.

Anatomy (Fig. 139).

The roof of the middle ear, or *tympanum,* is thin, and thus there is very little that separates the ear from the brain above.

The floor of the tympanum is thick, and separates it from the jugular fossa.

The anterior wall of the tympanum corresponds with the carotid canal, from which it is separated by a thin plate of bone, and has the Eustachian tube opening through it.

The posterior wall has several openings from the mastoid cells; where the openings do not exist, it is separated from the mastoid cells by only a very thin lamina of bone.

The outer wall is represented by the membrana tympani.

The inner wall has upon it many elevations and depressions, and separates it from the internal ear.

The mastoid cells occupy a position behind the tympanum, and open by several apertures into it through its posterior wall. In adults these cells may be said to consist of two portions. The horizontal are close to the posterior wall of the tympanum, and open into it. These cells form the mastoid antrum, which is bounded externally by a small piece of the squamous portion of the temporal bone which is immediately *behind and above* the external auditory meatus. The vertical cells are situated behind the horizontal, and occupy the mastoid process. The extent of the mastoid cells in the adult is about 1½ inches horizontally and 2 inches vertically—that is to say, from the external meatus backwards, and from the apex of the mastoid process upwards. It is important to remember that these cells encroach on the bony canal of the lateral sinus.

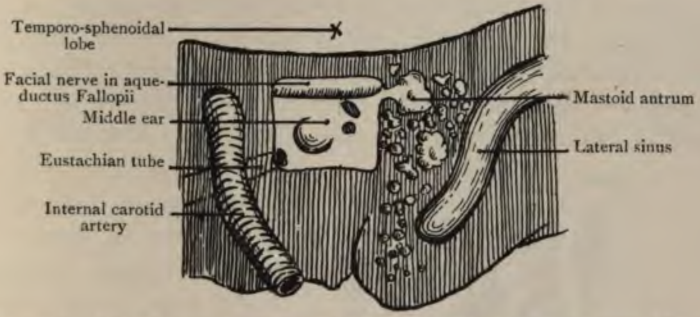

FIG. 139.—DIAGRAM TO SHOW THE IMPORTANT RELATIONS OF THE MIDDLE EAR AND MASTOID CELLS. (LEFT SIDE.)

As said before, the position of the lateral sinus is represented by a line drawn from the occipital protuberance to the external auditory meatus. To this is attached the tentorium cerebelli, which separates the cerebrum above from the cerebellum below and behind, and encloses and forms the walls of the lateral sinus.

The parts of the brain in immediate relation with the bones of the middle ear and mastoid cells are the middle and greater part of the temporo-sphenoidal lobes.

Trephining the Mastoid Antrum.

Operation (Fig. 140).

The head is shaved in the neighbourhood of the antrum. A flap is cut, with its convex edge just behind the attachment of the pinna. The flap is turned backwards, and all bleeding is arrested. A small trephine ½ an inch in diameter is applied a ¼ of an inch above and behind the centre of the meatus. It is made to penetrate from ½ an inch to ¾ of an inch in a direction slightly downwards and forwards. As soon as the crown of bone has been removed, the clearing out of the antrum may be completed with a gouge. Some surgeons prefer to do the whole operation with a gouge. When all the pus and dead bone have been removed, the antral cavity should be drained by a tube passing through it and out of the external auditory meatus, or into it alone, if the opening into the tympanum is not large enough to allow of the tube being passed through. The flap is then turned back and loosely stitched in position. Should the clearing out and opening up of the cells not appear sufficient—that is to say, should symptoms indicate that there is some further mischief—then the lateral sinus and the brain must be explored.

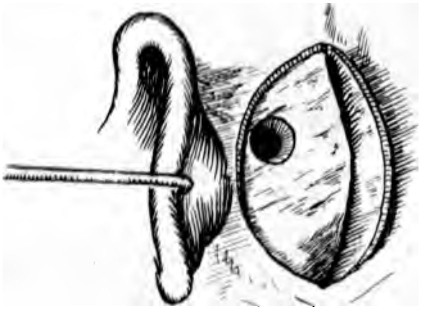

FIG. 140.—DIAGRAM OF THE OPERATION FOR TREPHINING THE MASTOID ANTRUM.

Many authors have given different directions for exploring the various parts of the brain through separate trephine holes. Here the positions for these various explorations will alone be given, and a full description will be confined to Dean's operation, as it is the simplest, quite as efficacious as any other method, and certainly not nearly so severe as some.

Positions for Trephining Parts around Middle Ear (Fig. 141).

An opening to explore the *anterior surface of the petrous bone and roof of the tympanum* is made 1 inch above the middle of the meatus. From this opening a probe can be passed between the dura mater and the bone.

The opening for the *temporo-sphenoidal lobe* is made 1¼ inches behind and 1¼ inches above the centre of the meatus.

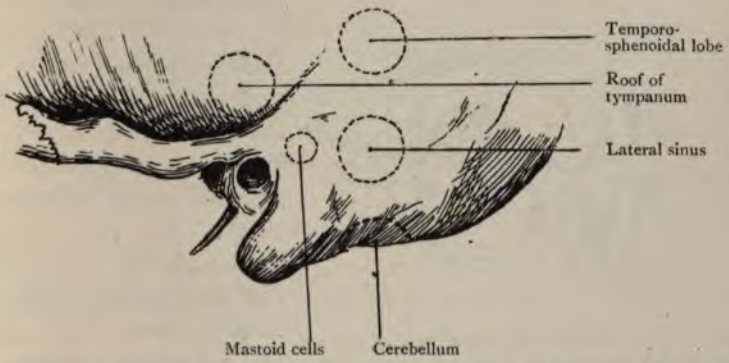

FIG. 141.—DIAGRAM TO SHOW THE POSITION OF TREPHINE CROWNS TO EXPOSE DIFFERENT PORTIONS OF THE BRAIN, MASTOID CELLS, ETC.

The opening for the *cerebellum* is 1½ inches behind and 1 inch below the base line.

The opening to explore the *lateral sinus* is 1¼ inches behind and ¼ of an inch above the centre of the external meatus.

Trephining to Explore the Lateral Sinus, Cerebrum, and Cerebellum (Dean's Operation).

The reason for exploring all three structures at the same time and through the same opening is that often from the symptoms it is impossible to discover which of the three structures is involved.

Operation (Fig. 142).

Presuming that the mastoid antrum has been opened, and not enough found there to account for the symptoms, the ends of the curved flap are prolonged backwards so as to expose more of the bone behind the ear. A trephine 1 inch at least in diameter is applied at the spot for exposing the sinus—that is to say, 1¼ inches behind and ¼ of an inch above the centre of the meatus. The crown of bone is removed, and the sinus exposed with some of the cerebrum above and some of the cerebellum below. Then, if necessary, with cutting bone forceps some of the upper part of the trephine hole can be cut away, and thus more of the cerebrum exposed above the lateral sinus. In like manner more of the cerebellum can be exposed below the lateral sinus. This done, an exploring syringe, or even a hypodermic syringe (the needle of the syringe must not be too small), is first passed into the lateral sinus. If no blood is drawn into the syringe, it proves that the sinus is thrombosed, and therefore must be laid open, the septic clot turned out and the sinus plugged to stop the bleeding. Should the sinus be shown to be free by pure blood coming into the syringe on aspirating, then attention should be turned to the cerebrum, and the needle inserted into it in various directions to see if there is an abscess. Should pus come into the syringe, the dura mater should be slit up, forceps passed into the abscess cavity, and the opening dilated; the abscess is washed out and a drainage-tube inserted. Should no abscess be found, attention must then be turned to the cerebellum,

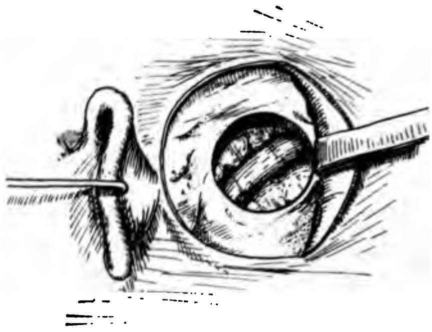

FIG. 142.—DEAN'S OPERATION FOR EXPOSING THE LATERAL SINUS, TEMPORO-SPHENOIDAL LOBE AND CEREBELLUM THROUGH ONE OPENING.

and that in like manner explored by the syringe, and in like manner dealt with if pus is discovered. Lastly, the skin flap may be turned back into place and secured, leaving room for the drainage-tube or the end of a strip of gauze to come out, should the sinus have had to be plugged.

If the sinus has been opened on account of a septic clot, the internal jugular vein in the neck on the same side should be ligatured, so as to prevent the extension of sepsis by the vein to the lung.

Memorandum.

Use a large enough trephine, and cut away bone from above and below the trephine hole, so as to expose well the cerebrum above and the cerebellum below the lateral sinus, if an abscess is found in one of these regions.

Trephining for Traumatic Epilepsy.

Operation.

The opening is made over the seat of injury. The operation is performed in exactly the same way as in any other case of trephining.

The crown of bone removed is carefully examined as to thickness, or irregularity, or any depressed portion. If nothing is found to be wrong with the bone in the neighbourhood of the trephine hole, a probe is inserted between the skull and the dura mater, and swept round for some distance, to make sure there is no depressed spicula of bone near to the trephine hole which may be the cause of the epilepsy. The dura mater is next examined to see if it is thickened or adherent to the brain below. If this is the case, it may be cut away.

The bone and dura mater being healthy, the latter should be opened, and the brain itself examined to see if there is any clot or subarachnoid cyst on it, or if there is any scarring of the brain. Should an organized clot or a cyst be found, the clot must be removed or the cyst drained. If there is a scar on the brain, it may be excised.

Trephining for Cerebral Tumour.

A cerebral tumour may occur in any part of the brain, and a diagnosis as to its position be extremely difficult; when, however, it occurs about a motor area its position may be sometimes diagnosed.

Anatomy (Fig. 143).

Description of the anatomy can be confined to the ascending parietal convolution and the position of the fissure of Rolando behind it, since it is about this fissure and the ascending parietal convolution that the motor centres are situated. The fissure of Rolando and the motor centres around it can be marked out by the following lines, which are simple and easy to remember: First should be found the coronal suture, which is represented by a line drawn from the centre of the zygomatic arch vertically upwards to the anterior fontanel. The fissure of Rolando is situated about the upper two-thirds of this line, being about 1¾ inches behind the line above, and about 1 inch behind below. This is a rough-and-ready means of finding it, but it is enough for practical purposes, and easy to keep in mind. Above, at the top of the fissure, are the centres for the muscles of the abdomen; next, those belonging to the leg, then those of the arm and hand, afterwards those of the face, and the lowest of all, those of the mouth and speech. Any very definite lines cannot always be correct, as skulls vary in shape and size. It must be remembered that the exact position of these centres can be made out when the skull is opened by stimulating the brain with an electric current.

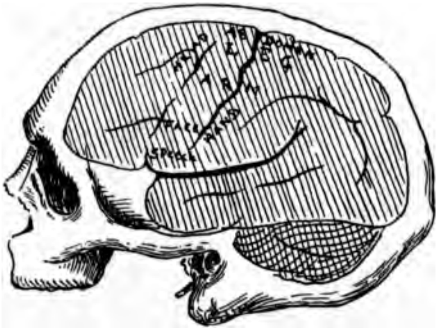

FIG. 143.—DIAGRAM OF THE SKULL, SHOWING THE BRAIN AND MAIN FISSURES, AND MOTOR CENTRES.

Operation.

The head being shaved and thoroughly cleaned, the position found by the above lines is marked out with an aniline pencil on the scalp, any particular area that requires trephining is approximately traced, and a small incision is made through the skin down to the bone; then a little cut is made in the bone with a gouge or drill, so as to mark the spot on the skull before the large skin flap is cut and reflected. A flap is then reflected, the mark on the bone found, and a large Horsley's trephine applied and the bone removed. If necessary, more bone may be removed by trephine or cutting-bone-forceps. The dura mater is divided around three-quarters of the trephine opening, about ¼ of an inch from the bone edge. The dura mater flap is reflected, and the brain examined to see if there is any bulging, alteration in colour, or any increased resistance. This being ascertained, the brain is divided with a scalpel vertically to the surface; any large vessels are avoided, and the tumour is exposed. This must then be enucleated with the finger or the handle of the knife, any severe bleeding from the cavity being controlled by pressure, or the large vessels gently ligatured. The cavity left by the removal of the tumour is drained, the dura mater flap is returned and sutured in its place by catgut sutures, and the skin flap secured in its place.

Memoranda.

I. Do not forget to mark out with the drill the spot on the skull before reflecting the skin flap.

II. Divide the dura mater ¼ inch from the edge of the trephine opening, thus leaving sufficient room to allow of its being sutured back in its place.

III. Remember that there may be difficulty in finding the limits of the growth, for many of these growths are not well, or even at all, encapsuled.

Trephining the Frontal Sinus.

Operation.

A vertical incision is made from the root of the nose, extending upwards. The bone is cleared of the soft parts, and a trephine is applied in the middle line; the crown of bone is removed and the frontal sinus dealt with as the case may require.

PART IV

CHAPTER I

OPERATIONS UPON THE BREAST

THE BREAST AND AXILLA.

Anatomy.

THE breast extends from about the third to the fifth rib. It is enclosed in two layers of fascia, and rests upon the deep fascia which covers the pectoralis major. The fascia crosses the axilla, and splits to enclose the latissimus dorsi. The breast is supplied by many small branches of different vessels; its chief artery, the long thoracic, runs along the lower edge of the pectoralis major. The chief lymphatics of the breast pass along the lower border of the pectoralis major, and empty themselves into the axillary glands.

The lymphatic glands about the axilla are situated as follows: The first row along the anterior wall of the axilla, the second row along and around the axillary vessels, and the third row, receiving the lymphatics from the back, chiefly occupies the posterior axillary fold, viz., along the latissimus dorsi.

The course of the axillary vessels and brachial nerves is represented by a line drawn from the centre of the clavicle to the insertion of the coraco-brachialis, about the middle of the inner side of the upper arm.

Removal of the Breast.

Operations.

1. Removal of breast.
2. Halsted's operation.
3. Thomas's operation for removal of innocent tumours.

1. Removal of Breast (Fig. 144).—The patient is brought to the edge of the table, the head and shoulders being slightly raised, and the arm of the affected side raised and held well away from the body.

The surgeon stands on the side to be dealt with. An elliptical incision is first made, commencing below the nipple. The centre of the incision is opposite the nipple, one end being just below the mamma, the other end being rather to the anterior part of the centre of the axilla. The incision itself is parallel to the pectoral margin. This incision is next carried well into the cellular tissue. Then, with the surgeon holding the breast slightly down, the upper elliptical incision is cut, its ends joining the ends of the lower incision. This incision is then deepened down to the pectoral muscle so as to give access to the under surface of the breast. The mamma is grasped and

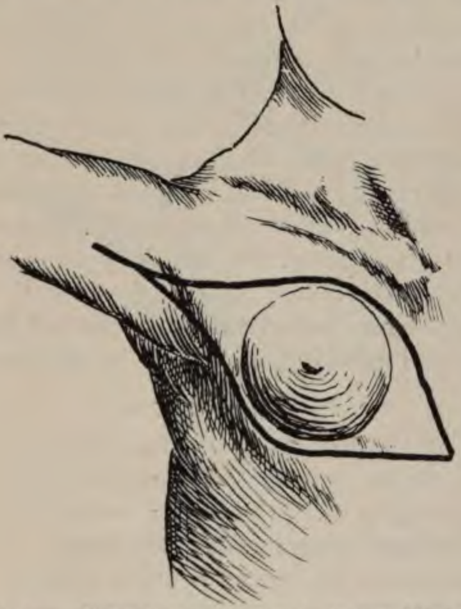

FIG. 144.—INCISION FOR REMOVAL OF THE BREAST.

dragged away from the chest, a few touches of the knife separating it from the pectoral muscle.

Should it be deemed advisable to open the axilla the incision is prolonged up into it. The skin and the deep fascia enclosing the axilla are divided, and the latter opened. The glands and thickened lymphatics, or even the cellular tissue, are best cleared out with the fingers or the handle of the knife. This must be most thoroughly done, and the space under the pectoral extending up to the clavicle thoroughly explored. Should there be any difficulty in reaching any gland or thickened or matted tissue, the pectoral muscles should be divided. In clearing out the axilla, there is frequently severe bleeding from veins being divided close to the axillary vein. These must be rapidly secured. Should the growth or glands involve the axillary vein, or be so firmly attached to it as to prevent thorough removal, the vein may be ligatured in two places, and the intervening part removed with the growth. When the axilla has been thoroughly cleared, good drainage must be secured by making an opening in the posterior flap.

Memoranda.

I. Always cut the breast off very freely and remove all skin that appears to be in the least adherent to the breast or involved in the growth. It is better to leave an open wound rather than the least morsel of diseased tissue.

II. Always remove the pectoral fascia with the breast—that is to say, cut the deep pectoral fascia off the pectoralis major.

III. In removing breasts in very thin subjects do not keep the point of the knife too perpendicular to the surface, for fear of perforating the intercostal spaces and so opening the pleural cavity.

IV. When it is necessary to clear out the axilla, remember the line of the axillary vessels, and early in the dissection freely expose the vessels, so as to be able to keep an eye on them during the clearing out. If this is not done, they may be wounded before one is aware of their being in the neighbourhood of the piece of growth or gland which is being removed.

V. Thoroughly clear out all cellular tissue and lymphatics along the lower border of the pectoralis major—that is to say, that between the breast and the glands in the axilla.

2. Halsted's Operation (Fig. 145).—The outer or axillary limb of the incision runs up nearer to the clavicle than in the previous operation, and a large lower flap is thus formed and turned down. The whole of the breast, axillary glands, and fat, and the sternal portion of the pectoralis major, are removed in one piece. The pectoralis minor is also divided or removed if considered necessary. The edges of the wound are then brought together if possible, or the wound allowed to granulate, and subsequently grafted by Thiersch's method.

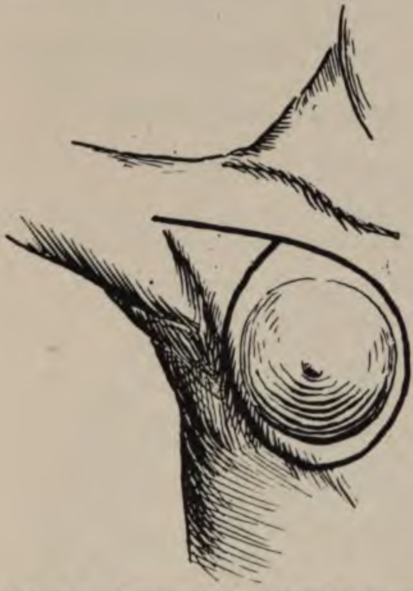

FIG. 145.—INCISION FOR HALSTED'S OPERATION.

3. Thomas's Operation for Removal of Innocent Tumours.—In this operation the tumours are removed from the under surface of the breast. An incision is made along the groove between the lower margin of the breast and the chest wall. Thus the pectoral muscles are reached under the breast; the breast is then turned up. The under surface of the breast is cut into so as to expose the tumour, which is shelled out. The breast is replaced and good drainage provided.

CHAPTER II

OPERATIONS UPON THE THORAX

LUNGS AND PLEURA.

Anatomy (Fig. 146).

In the middle line the junction of the first and second pieces of the sternum indicates the position of the second rib.

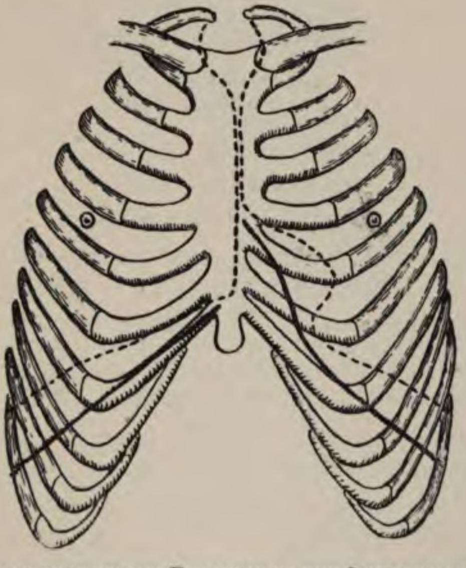

FIG. 146.—DIAGRAM TO SHOW THE RELATION OF THE LUNGS TO THE CHEST WALL. The dotted line shows the edge of the lungs, and the thick black line the pleura.

The lower border of the pectoralis major at the sternum represents the position of the fifth rib.

With the arm raised from the side, the highest visible digitation of the serratus magnus denotes the position of the sixth rib.

The scapula lies between the second and seventh ribs.

The internal mammary artery is indicated by a line drawn perpendicularly ½ inch from the edge of the sternum.

Outline of Lungs.—In front the lungs meet in the middle line, opposite the first and second pieces of the sternum. The edge of the right lung continues vertically downwards to the junction of the sixth rib with the sternum, and then slopes along the line of the sixth rib. The edge of the left lung runs down behind the sternum as far as the junction of the fourth rib with the sternum, where it turns to the left, and is represented by a line drawn from the fourth costal cartilage to the apex of the heart. The lower border of the lungs is represented by a band encircling the chest, which commences in front at the junction of the sixth rib with the sternum, and behind on a level with the tenth dorsal spine. The pleura extends further down than the lungs, being indicated by a line about 1½ inches lower than that which traces the lower level of the lungs.

Opening the Pleura.

Operations.

1. Incision.
2. Resection of rib.
3. Estlander's operation
4. Drainage of lung cavities.

The position at which the operations are to be performed depends on whether the opening is for a general collection of fluid or for a local accumulation. If the fluid is localized, the surgeon should operate over it.

1. Incision. — If there is a general collection of fluid, Godlee advises that the chest be opened about the ninth rib, just outside the angle of the scapula. The patient is supported over the edge of the bed and slightly rolled over on to the sound side. Sufficient chloroform is given to dull pain. With the finger-nail the upper border of the rib in the space to be opened is found; an incision is made about 1½ to 2 inches long in the line of the rib. This exposes the muscles. A director is then thrust through the muscles into the pleura; along this dressing forceps are passed to enlarge the wound. The finger is then inserted and the cavity gently explored. Should the operation have been done for a localized collection of fluid (if the incision is not at the lower part of the cavity) a counter-opening is made through a space lower down and a drainage-tube inserted. Should the opening not be sufficient to allow of free drainage, a piece of rib must be resected.

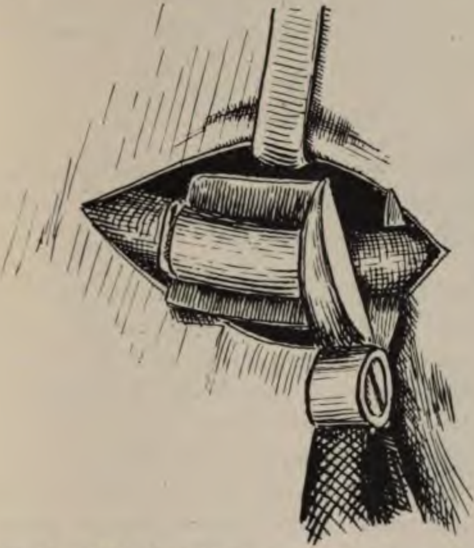

FIG. 147.—THE OPERATION FOR RESECTING A PORTION OF RIB.

The rib has been divided on the left side and the periosteum turned back. The piece of rib is just about to be completely removed by cutting with the forceps.

2. Resection of Rib (Fig. 147).—A longitudinal incision is made over the piece of rib to be resected, thoroughly dividing the periosteum; the latter is then pushed off the rib both upwards and downwards so as to free the bone of its periosteum. Sharp-cutting bone forceps are inserted between the separated periosteum and the rib, which is divided first at one end of the incision and then at the other, so that about 1½ to 2 inches of the bone are removed. The periosteum is then freely incised, and the pleura opened.

3. Estlander's Operation.—This consists in the removal of many pieces of rib, so as to allow the chest wall to fall in and unite to the lung, thus obliterating an old abscess cavity.

The operation is performed exactly as above described for resecting a rib, and as many ribs as thought desirable removed over the cavity. Some operators prefer to turn up a large U-shaped flap; others make multiple incisions, and remove each piece of rib through a different incision. Any thickened pleura must be removed, and all unhealthy granulation tissue thoroughly scraped away.

Memorandum.

The bleeding is free in this operation, and must be quickly stopped, for these patients are as a rule very ill, and have not the strength to endure severe bleeding.

4. Drainage of Lung Cavities.—The cavity in the lung being diagnosed by the physician, the operation is performed as follows: The needle of an exploring syringe is pushed into the chest, and the escape of pus shows the position of the cavity. The surgeon, with the syringe still in the chest, cuts down, opens the abscess cavity, explores its extent with his finger, and deals with it according to circumstances, resecting rib or ribs as the case may need. The important point in this operation consists in there being firm adhesions between the lung pleura and the parietal pleura. If this is not the case, when the opening into the pleura and lung has been made a general empyema will result. Godlee advises that if there are no adhesions, or if they are insufficient, the lung pleura should be carefully stitched to the parietal pleura so as to secure firm adhesion. Then, some days later, when the two layers are firmly fixed, the septic cavity in the lung is freely opened. Thus the occurrence of a general septic empyema is prevented.

THE HEART AND PERICARDIUM.

Anatomy.

The upper level of the heart and pericardium is represented by a line drawn across the chest on a level with the third costal cartilage, extending ½ an inch to the right and 1 inch to the left of the sternum.

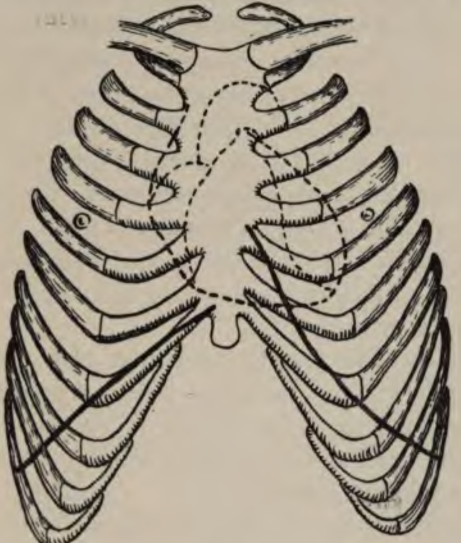

FIG. 148.—SURFACE MARKING OF THE HEART AND PERICARDIUM.
The dotted line shows the outline of the heart, the thick black line that of the pleura.

The apex is indicated by a point 1½ inches below the left nipple and 1½ inches to the sternal side.

The lower border is shown by a line drawn from the apex of the heart to the junction of the gladiolus with the ensiform cartilage.

The right border continues the last line upwards, so as to join the right side of the base. This represents the right auricle of the heart.

The left border is shown by a line drawn from the left extremity of the base line to the apex. This represents the left auricle of the heart. To find the area of pericardium in contact with the chest wall and uncovered by lung, draw a circle 2 inches in diameter around a point midway between the nipple and the end of the sternum (the junction of the gladiolus and ensiform cartilage).

Opening the Pericardium.

Operations.

1. Aspirating.
2. Incising (Allingham).

1. Aspirating.—The best place for aspirating is about 1 inch from the sternum on the left side in the fifth space. The needle must be very cautiously introduced, its steady insertion being insured by keeping the point of the finger upon it, gradually letting it glide past the finger. This prevents the needle from being suddenly inserted into the pericardium, and there is less fear of wounding the heart. If pus is present, with the trocar still *in situ*, an incision is made down on to the pericardium, which is cautiously opened with dressing forceps. If there is not sufficient room, a portion of the fifth costal cartilage may be removed.

2. Operation for freely opening the Pericardium.—An incision is made 3 inches in length from the left costo-xiphoid angle along the lower border of the left seventh costal cartilage. The cartilage is freely exposed by dividing all the abdominal muscles attached to its lower border. This exposes the origin of the diaphragm and the cellular interval between it and the xiphoid cartilage. This interval is enlarged by tearing or cutting through the muscle of the diaphragm. A mass of fat will then be exposed lying in front of the pericardium; this is drawn out of the way and the pericardium exposed; the latter is then incised, and the wound enlarged with dressing forceps. Neither the peritoneal nor pleural cavities are opened in this operation.

Memoranda.

I. Although the above operation is easy in a child or adult with flexible cartilages, when such is not the case it is necessary to remove 2 inches of the seventh cartilage after the first incision in order to obtain sufficient room in the xiphoid angle.

II. Care must be taken to prevent wounding the peritoneum; if the incision be made just below the cartilage, there will be very little danger of doing so. The pleura should not be met with at all.*

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* This operation has been performed recently, with complete success, in a case under the care of Dr. Arthur Latham and Mr. Pendlebury at St. George's Hospital (*Lancet*), and also in two cases by the author.

PART V

CHAPTER I

LIGATURE OF VESSELS OF THE ABDOMEN

ABDOMINAL AORTA.

THE vessel extends from the opening in the diaphragm opposite the twelfth dorsal vertebra, and passes downwards along the left and front of the spine to its termination opposite the middle of the fourth lumbar vertebra, where it divides into the common iliac vessels. This point is about an inch below and to the left of the umbilicus.

The vessel may be superficially marked out by a line drawn from about 4 inches above to a point 1 inch below the umbilicus.

The cœliac axis comes off from the vessel about 4 inches above the umbilicus. The superior mesenteric vessel is just below this. The renal vessels are about ½ inch below the superior mesenteric, and about 3 inches above the umbilicus.

The inferior mesenteric artery comes off about 1 inch above the umbilicus.

Owing to the numerous branches coming off the aorta above the umbilicus, it would be unwise to ligature it in this part; therefore the spot to choose for ligature is between the giving off of the inferior mesenteric, viz., 1 inch above the umbilicus, and the point of its division, viz., 1 inch below the umbilicus.

Ligature of the Abdominal Aorta.

ANATOMY (Fig. 149).

In Front.

Omentum, duodenum.
Mesentery and small intestines.
Stomach.
Pancreas.

Right.
Vena cava.
Thoracic duct.

[**Artery.**]

Left.
Sympathetic nerves.

Behind.
Lumbar veins.
Thoracic duct.

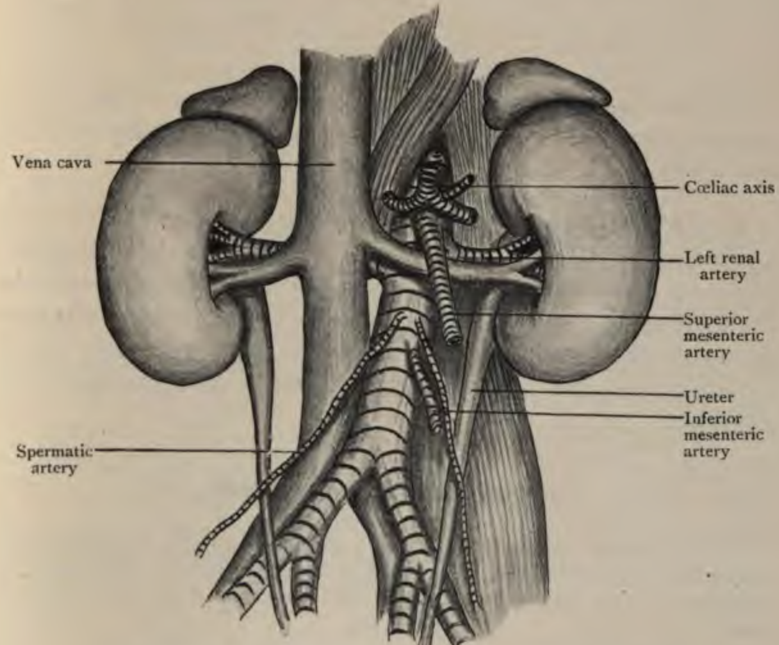

FIG. 149.—THE ANATOMY OF THE ABDOMINAL AORTA.

Operations.

1. Through the peritoneum.
2. Behind the peritoneum.

1. Operation through the Peritoneum.—The patient lies on his back, with the shoulders slightly raised, so as to relax the abdominal muscles. An incision 4 inches long is made, with its centre to the left of the umbilicus. The abdominal cavity is opened. The intestines are to be packed out of the way with sponges, and then held back by retractors. The position of the vessel is made out by its pulsation, and the peritoneum covering it must be carefully scratched through and the vessel exposed. The aneurism needle is kept close to the vessel, and is passed from right to left.

Memorandum.

Do not include in the ligature any branches of the aortic sympathetic. This is avoided by keeping the needle close to the vessel.

2. Operation behind the Peritoneum.—This is performed in the same manner as the operation for ligaturing the common iliac presently to be described. The incision extends from the tenth rib, and curves forwards to the anterior superior spine of the ilium. The belly wall is then pushed forwards together with the peritoneum, and the vessel exposed and ligatured.

COMMON ILIAC ARTERIES.

These arteries are represented by a line drawn from a point 1 inch below and to the left of the umbilicus, to the centre of Poupart's ligament. The upper 2 inches of the line represent the common iliac.

Ligature of the Common Iliac Arteries.

ANATOMY (Fig. 149).

LEFT.

Front.

Peritoneum and intestine.
Sympathetic nerves.

Inside.		*Outside.*
Superior hæmorrhoidal artery.	[**Artery.**]	Psoas.

Below.

Left common iliac vein.

RIGHT.

Front.

Peritoneum and intestine.
Sympathetic nerves.

Inside.		*Outside.*
Left common iliac.	[**Artery.**]	Psoas and inferior vena cava.

Behind.

Right and left common iliac veins.

Operations.

1. Through the peritoneum.
2. Behind the peritoneum (Mott).
3. Behind the peritoneum (Crampton).

I. Operation through the Peritoneum.—The patient lies on the back, as in ligature of the abdominal aorta. An incision is made in the line of the artery, commencing about 1 inch above the umbilicus and extending downwards for 4 inches. The abdomen is opened, the intestines kept out of the way, and the artery sought for. The peritoneum covering it is scratched through, the vessel cleared, and an aneurism needle passed. The operation is performed in much the same way as that for tying the abdominal aorta.

Memorandum.

Do not injure the veins, especially when tying the right vessel, which is surrounded by veins on nearly all sides.

2. Mott's Operation (Fig. 150).—In this operation a curved incision about 6 inches long is made commencing just outside the centre of Poupart's ligament, and 1 inch above it. This is carried outwards towards the crest of the ilium, and from thence upwards towards the ribs. The abdominal muscles are divided, the fascia transversalis is exposed and carefully divided on a director to the extent of the superficial wound. The peritoneum is then exposed and raised until the psoas muscle is seen. About the inner side of the muscle the artery will be found. The vessel is then cleared and the aneurism needle passed.

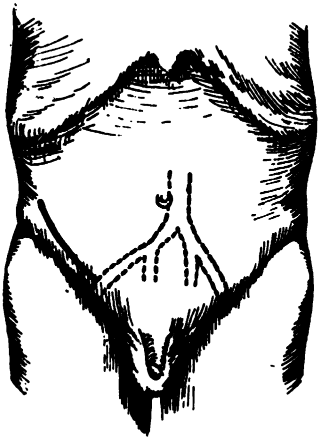

FIG. 150.

Memoranda.

I. Do not open the peritoneum while stripping it up in exposing the artery by this method.

II. Be careful not to include the ureter in the ligature or to injure it.

3. Crampton's Operation.—The patient is turned somewhat on to the sound side. A curved incision, the concavity towards the umbilicus, is made from the last rib at its anterior extremity, to the anterior superior spine of the ilium. The abdominal muscles are divided to about an inch in extent close to the anterior superior spine down to the peritoneum. Into this wound the finger is inserted along the line of the iliac crest, separating the peritoneum from the iliac fascia. One blade of a pair of scissors is passed into the wound and along the finger, and the abdominal muscles are divided at their attachment to the iliac crest. When this has been done, the peritoneum is pushed up and the vessel exposed and ligatured.

Collateral Circulation after Ligature of the Common Iliac Arteries.

Internal mammary and lower intercostal + Deep epigastric.
Superior hæmorrhoidal + Inferior and middle hæmorrhoidal.
Lumbar + The ilio-lumbar and circumflex iliac.
Sacral + Lateral sacral.

CHAPTER II

OPERATIONS UPON THE INTESTINES

BEFORE proceeding to the descriptions of the different operations on the abdominal viscera, it is necessary to describe the methods of dealing with and suturing the intestines, as they are often implicated or involved in operations upon the other abdominal organs. These prior observations will be general; the anatomy of the intestines will be described when special operations are discussed.

TREATMENT OF ADHESIONS.

Small and soft adhesions may be torn through, or the parts separated by wiping them asunder with a sponge.

Thick adhesions should be divided between two ligatures. If they are broad and very firm, a portion may have to be left, entailing the retention also of some portion of an organ the rest of which is to be removed. Take as an example the firm adhesion of an ovarian cyst to the intestine. In this case, as the ovarian cyst is to be removed, a piece of its wall is sacrificed and left adherent to the intestine which is not going to be removed.

METHODS OF SUTURING THE INTESTINE.

The best of many methods are:

Continuous suture (Dupuytren).
Continuous suture (Lembert).
Interrupted suture (Lembert).
Interrupted suture (Czerny).

Continuous Suture (Dupuytren) (Fig. 151).—The edges of the wound and the peritoneum covering the intestine are turned inwards, and then the two parts of the peritoneum in contact are sewn together with a continuous suture, the needle taking up the peritoneal and muscular coats only.

Be careful to sew well beyond the ends of the wound, or leakage may occur at the ends of the fold.

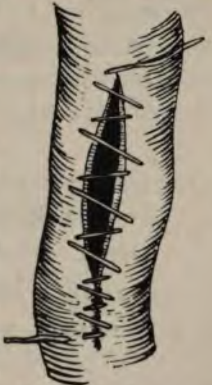

FIG. 151.—DUPUYTREN'S CONTINUOUS SUTURE.

Continuous or Interrupted Suture (Lembert) (Figs. 152 and 153).—On either side of the wound in the intestine the peritoneum and some of the muscular coat of the bowel are picked up about $\frac{1}{4}$ of an inch from the wound. The needle is passed through the peritoneum and muscular coat, then across the wound, and again through the peritoneum and muscular coat on the other side of the wound, about $\frac{1}{4}$ of an inch from its edge. This is done with separate sutures, about $\frac{1}{8}$ of an inch to 1 inch. The edges of the peritoneum are then turned into the wound on both sides and the sutures are tied, thus bringing peritoneum to peritoneum. The mucous coat must on no account be perforated. This suture may also be used as a continuous suture (Fig. 152).

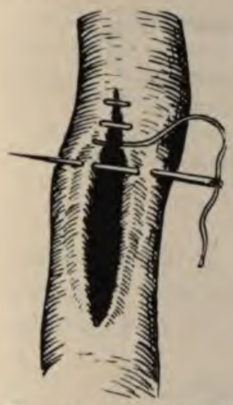

FIG. 152.—CONTINUOUS LEMBERT SUTURE.

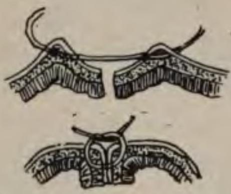

FIG. 153.

Interrupted Suture (Czerny's) (Fig. 154).—This is the same as Lembert's suture, but previous to inserting it the *mucous coat* on one side of the wound is sewn to the *mucous coat* on the other side of the wound. The knots of this row are turned as far inwards as possible. When the mucous coat is sewn up, the Lembert's sutures are inserted through the peritoneum and muscular coats, as previously described.

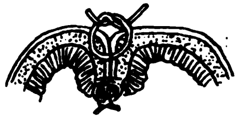
FIG. 154.

OPERATION FOR UNITING INTESTINES END TO END AFTER RESECTION OF A PORTION, AND INTESTINAL ANASTOMOSIS.

Any of the following methods may be used:

1. Intestines may be united end to end (Fig. 155).

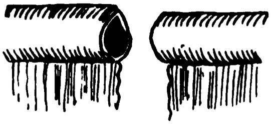
FIG. 155.

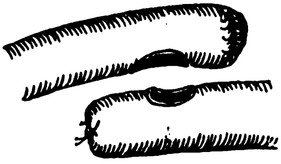
FIG. 156.

2. Intestines may be united by sewing up the ends, and applying the side of one piece to the side of the other (Fig. 156).

3. One part of the small intestine may be united to another part of the small intestine (Fig. 157).

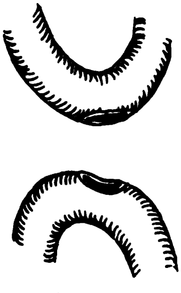
FIG. 157.

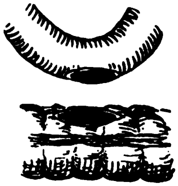
FIG. 158.

4. The small intestine may be united to the large intestine (Fig. 158).

5. The small or large intestine may be united to a hollow viscus (the stomach or gall-bladder) (Fig. 159).

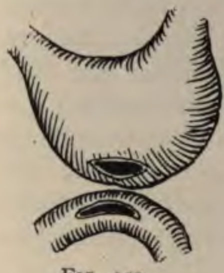

FIG. 159.

These unions may be performed either by the use of bobbins, plates, or by simple suture. The simplest and most commonly used methods are:

Mayo Robson's bobbin.
Senn's plates.
Murphy's button.
Allingham's bone bobbin.
Simple suture.

Should the surgeon have none of these appliances at hand, the simple suture must be employed. The disadvantage of the latter method is the time it takes.

Mayo Robson's Bobbins (Fig. 160) are used as follows:

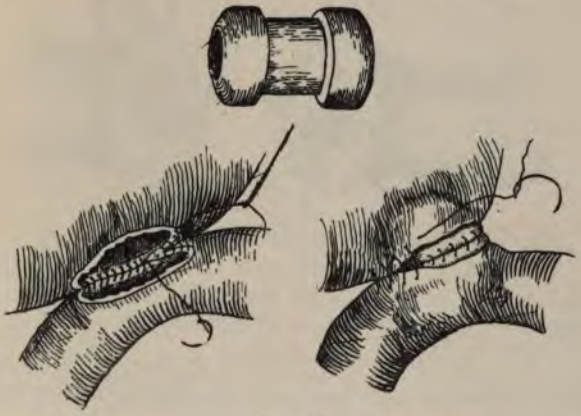

FIG. 160.

The bobbin is shown above. In the left-hand drawing the openings are shown ready for the introduction of the bobbin. The right-hand diagram shows the bobbin in position, with the muco-mucous stitch completed, and the sero-serous stitch in the process of completion.

For performing a lateral or side-to-side anastomosis, two pieces of fine silk about 18 inches long are threaded upon fine needles. An opening is made in the intestine of the necessar size to admit the bobbin easily, and a similar opening made i the other portion of intestine which it is proposed to anastomose. The two posterior edges of the wounds are united by sero-serous suture, which is left long; then the edges of th mucous membrane similarly united by a muco-mucous sutur The bobbin is then inserted one end into each opening, th muco-mucous stitch is completed all round in front, and, lastly the sero-serous stitch is completed, thus shutting in the bobbin The ends of the muco-mucous stitch are tied and cut off befor finishing the serous stitch.

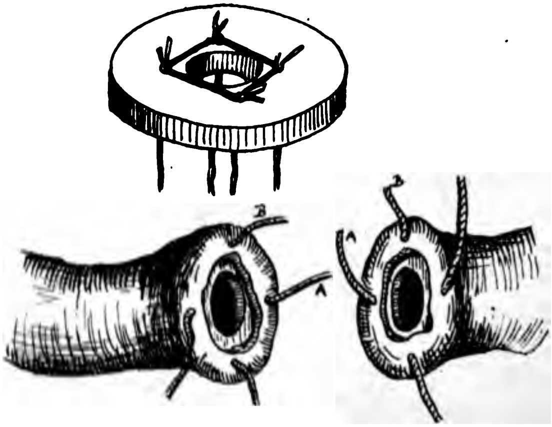

FIG. 161.

The upper diagram shows one plate with the ligatures attached. The lowe diagram represents the two plates *in situ* preparatory to tying the ligature A is tied to A, and B to B, etc.

Senn's Plates (Fig. 161) can be used in any of the abov operations.

In end-to-end anastomosis the plates are round. A plate i inserted into one end of the divided intestine, and the fou strings made to perforate the bowel at four points about ¼ a inch from its edge. The same i the intestine. These four sutur to the four sutures of the other plate, each to each and the ends cut short; a superficial row of Lembert's or Dupuytren's sutures is inserted when the plates have been approximated.

Murphy's Button (Fig. 163).—Into the end of the divided gut which is to be united a running thread or purse-string suture is sewn; then one half of the button is inserted into it, and the running thread drawn up so as to fix the intestine around the shaft of the button, the end of the button being held on a clip while it is inserted. The other half of the button is in like manner secured in the other end of the intestine. The halves of the button are then pressed gently together, so that the two peritoneal surfaces of the intestine are brought in contact.

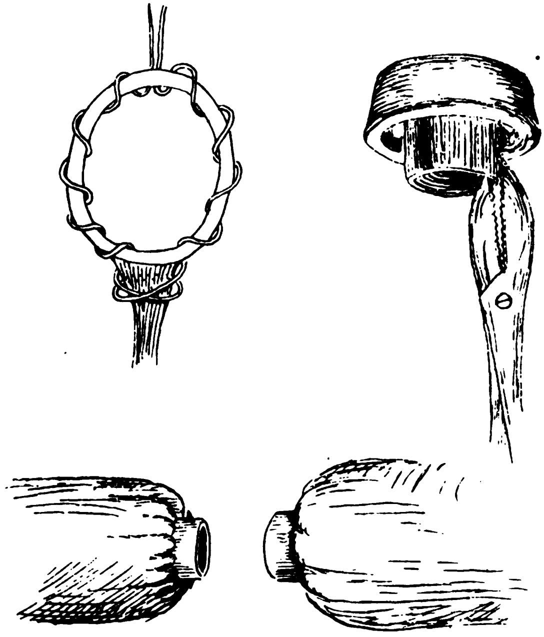

FIG. 162.—MURPHY'S BUTTON.

The upper left-hand diagram shows the method of passing the purse-string suture, the upper right-hand diagram the method of holding the halves of the button, and the lower diagram the halves inserted into the intestine and ready to be fixed together.

Memoranda.

I. The purse-string suture should be passed close to the edge of the intestine all round, and the ends crossed so as not to leave a gap when drawn tight.

II. Make certain that no mucous membrane is protruding when the button is pushed together, as the button cannot subsequently be undone if mucous membrane is found to be protruding after it is closed.

Allingham's Bobbin (Fig. 164).—It has the appearance of two truncated cones with their narrow ends together. The line of junction of the cones is hard bone. The bases of the cones are decalcified up to the narrow central belt, which is not decalcified, and is about $\frac{3}{10}$ of an inch in width. A purse-string stitch is sewn around each end of the gut; then one end of the bobbin is inserted into one end of the intestine and the suture pulled tight; the other end of the bobbin is inserted into the end of the other piece of intestine and its purse-string suture pulled tight also. The fact of pulling these purse-string stitches tight makes the two ends of intestine (resting over the cones) come close together. A few superficial sutures may be required to make the junction secure.

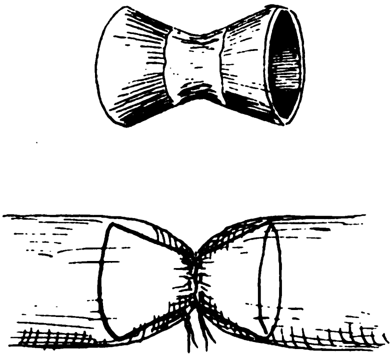

FIG. 163.—ALLINGHAM'S BUTTON.
The upper figure shows the bobbin; the lower figure shows the bobbin *in situ*, with the purse-string sutures pulled tight.

Simple Suture may be used in all anastomoses. In end-to-end unions the mucous coats are first united; indeed, the first step of Czerny's suture is used, and then the muscular and serous surfaces brought into apposition by Lembert's suture, which is the second step of Czerny's suture. The same method may be applied in uniting the intestine to a hollow viscus.

Maunsell's Method (Fig. 165).—The two ends of the bowel are brought together by two temporary sutures passed through all the coats of the intestine, one at the mesenteric junction and the other opposite this. A slit about 2 inches long is then made in the long axis of the proximal part of the gut some distance, 1 to 2 inches, from the divided end. The ends of the sutures described above are then passed up the gut and out of the slit. These are then pulled upon, so that the two ends of the divided gut are drawn by the sutures through the slit in the intestine, one end being invaginated into the other. The assistant holds the ends of the temporary sutures up and apart while the operator passes sutures through both sides of the bowel (about ¼ inch from the edge), including all the coats. Each suture is hooked up from the centre of the invaginated gut, divided, and tied on both sides. About ten such sutures are passed. When thoroughly secured the temporary sutures are cut short, the invaginated ends are put back into the intestine, and the longitudinal incision sewn up with Lembert's sutures.

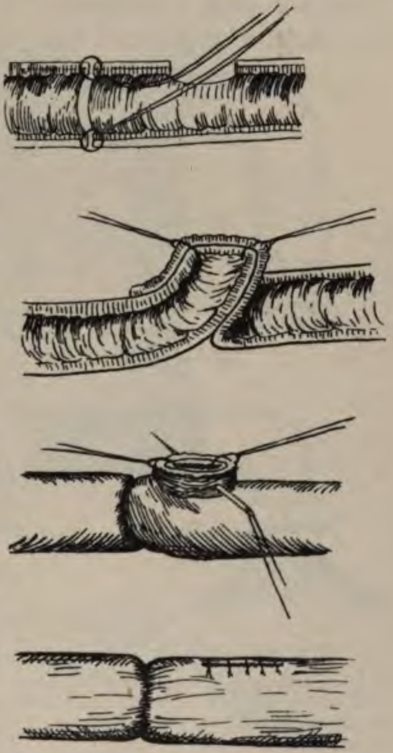

FIG. 164.—MAUNSELL'S METHOD. The diagram represents the various step s of the operation.

THE USE OF PAUL'S TUBES.

In all cases where there is great distension and the intestine must be opened *at once*, the chance of any leaking of fæces into the abdominal cavity can be obviated by the use of Paul's tubes. They are used as follows: The gut is pulled well into the wound, and the edges thoroughly surrounded with strips of antiseptic gauze. A large sheet of thin indiarubber is then taken, and a small hole made in it, and the hole placed over the gut, which is then pulled through it. If the hole in the indiarubber sheeting has been made fairly small, when stretched it grips on the loop of gut and embraces it at every point An incision just large enough to take a Paul's tube is made, and the tube inserted quickly, and secured in place by a ligature firmly tied round the walls of the gut. To the end of the glass tube, outside the gut, an indiarubber tube is attached; by this means the fæces and gas are carried into a pan outside the bed, and no soiling of the wound is possible. In twenty-four hours, if desired, the Paul's tube may be removed, for by that time all communication with the belly cavity is completely shut off by lymph.

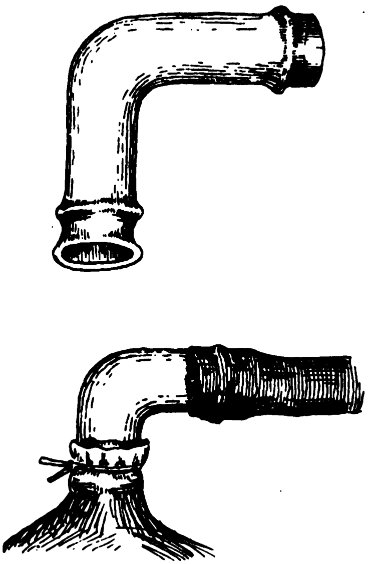
FIG. 165.—PAUL'S TUBES.

The lower drawing shows the tube tied into a loop of intestine, and with an indiarubber tube attached to its other end.

THE ABDOMINAL PARIETES.

Anatomy (Fig. 166).

In the middle line of the abdomen, extending from the ensiform cartilage to the pubes, is the linea alba. A little further out are the lineæ semilunares, which extend in a slightly curved direction (the concavity inwards) from the lower part of the seventh rib to the spine of the pubes. These represent the outer border of the recti muscles, and are about 3 inches from the umbilicus on each side.

The layers forming the abdominal wall in the upper three-quarters, over the recti, are from before backwards: External oblique, anterior tendon of internal oblique, rectus, posterior tendon of internal oblique, transversalis tendon, fascia transversalis, subserous areolar tissue, and peritoneum. In the lower quarter of the belly-wall the arrangement of these structures is a little different, all the tendons passing in front of the rectus muscle; thus, in this region the order from before backwards is: tendon of external oblique, tendon of internal oblique,

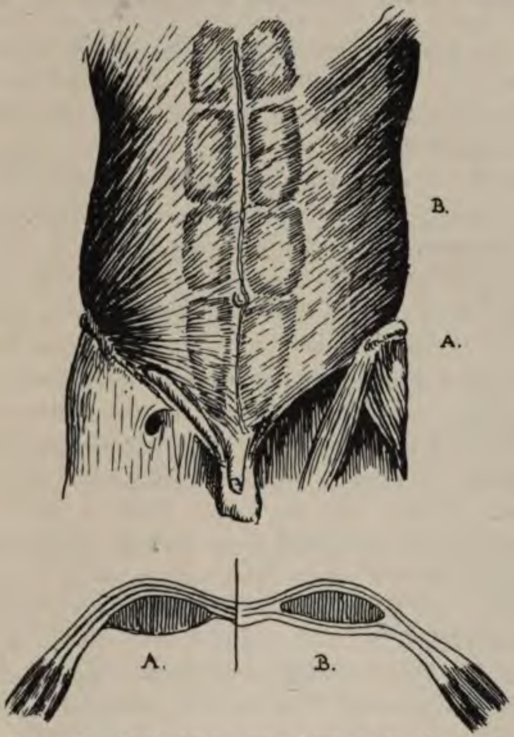

FIG. 166.—DIAGRAM OF THE ABDOMINAL MUSCLES.

The right side shows the external oblique, the left side the internal oblique. The lower diagram shows the parts A and B in transverse section, and illustrates the arrangement of the rectal sheath.

tendon of transversalis muscle, rectus muscle, transversalis fascia, subserous areolar tissue, peritoneum.

Beyond the linea semilunares the structures from before backwards are: external oblique muscle, internal oblique muscle, transversalis muscle, transversalis fascia, subserous areolar tissue, peritoneum.

Operation for dividing the Abdominal Wall.

Clearly this is always necessary before one can deal with the structures inside. It will therefore be described in detail here once and for all, and on future occasions this part of the operation will be ignored.

The patient is put thoroughly under an anæsthetic, and the parts are cleaned and surrounded with aseptic towels; the finger and thumb of the left hand are placed over the part to be divided so as to steady the skin. The skin is incised, and the cellular tissue freely divided down to the muscles. All small vessels in the cellular tissue are clipped. The muscles being reached, if in or about the middle line, the tendon of the external oblique is divided from end to end of the wound; the recti muscles are then split with the fingers in the direction of the wound, thus exposing the posterior tendon of the internal oblique and transversalis muscle. This is picked up with forceps, and carefully opened from end to end of the wound. The subserous areolar tissue and transversalis fascia are torn through with the fingers, and the peritoneum reached; this is cautiously picked up with forceps, and opened quite close to the apex of the forceps; the peritoneum clipped on both sides and the finger inserted. The surgeon, being positive that there is no structure between the finger and the peritoneum, divides the latter with scissors from end to end of the wound. If the incision is made exactly in the middle line—that is to say, over the linea alba—there is no muscular tissue to interfere with the operation. Indeed, as soon as the linea alba is divided the subserous areolar tissue is reached, and then the peritoneum. When incising in any part beyond the edge of the recti muscles, the different muscles are divided or torn through in the direction of their fibres.

Memoranda.

I. Always divide or separate all structures from end to end of the wound.

II. Do not divide the abdominal wall in the middle line —that is to say, through the linea alba. Diverge a little to one side or the other, as the after-union is firmer when the division has been through muscle than is the case when it has been through tendon only.

III. When the muscles are reached, they should be split with the fingers until the transversalis fascia is arrived at.

IV. Always remember that the transversalis fascia is mixed up with the subserous areolar tissue, and do not think that this is the omentum, and that the peritoneum has been opened.

V. When opening the peritoneum, be most careful that in picking it up no deeper abdominal structure is included in the forceps, and thus wounded.

VI. Introduce the finger into the opened peritoneum, and divide it with scissors along the rest of the length of the incision, the finger in the abdomen being the guide that there is nothing with the peritoneum while the latter is being divided.

RESECTION OF A PORTION OF INTESTINE.

The abdomen being opened, the piece of intestine to be resected is sought for and drawn out of the belly, the wound being filled up with sponges so as to stop any bleeding into the abdominal cavity. The intestine is then emptied just above and below the part to be removed by pressure with the fingers, and controlled by the assistant or by Makin's intestinal clamp. What answers quite as well is to perforate the mesentery above and below the part to be resected, pass a piece of thin drainage-tube through the mesentery, and lightly tie the tubes so as to clamp the intestine above and below. This being done, the piece of intestine is excised between the clamps. The division of the gut should be quite an inch from the clamps, the distance varying according to the

mode of union to be employed. The gut having been
a **V**-shaped piece is cut out of the mesentery. The bas
V is at the intestinal border, the apex towards the me
attachment to the back of the abdomen. Any small ve
the intestine or mesentery that may bleed are ligature
cut edges of the mesentery are sewn together—that is
the arms of the **V** brought together—after the ends
intestine have been united by any of the methods pr
enumerated (page 232). The clamp or drainage-tu
removed. After making sure that there is no leaking
the intestine gently into the abdomen, all the sponges
previously been removed. The abdominal wall is then

Sometimes it is better to unite the intestines side-
instead of end-to-end. In this case all the previous de
followed, but in addition, after cutting away the po
intestine, the ends are sewn up by Dupuytren's, Le
or Czerny's methods. Then about 3 inches from eac
slit is made in each piece of gut, and these slits, which
be about 1½ inches long, are applied side to side, and u
bobbins or the simple suture.

SHORT CIRCUITING INTESTINE.

The two loops which are to be united to each other ar
outside the abdomen, and, both having been emptied
contents, are controlled by drainage-tubes or clamps.
tudinal incision about 1½ inches in length is made int
and these openings united one to the other over a bobbi
simple suture, as in the previous operation.

Memoranda.

I. Protect the abdominal cavity thoroughly with spo
as to prevent the possibility of any blood or discharge
into it.

II. Ligature any vessels likely to bleed.

III. After loosening the clamps, wait to see if there weak point or any oozing of fluid between the united portions before attempting to return the treated gut.

IV. If there is any omentum in the neighbourhood, it may be twisted around the united portion and sutured over it so as to make an omental graft. In this way sometimes an additional protection may be insured.

V. When possible, make the incision into the intestine in that part of the gut which is opposite to the mesenteric attachment.

JEJUNOSTOMY.

Anatomy.

The jejunum is the upper and freely movable part of the small intestine. The point where it becomes ileum is impossible definitely to settle, the one gradually passing into the other. The jejunum is thicker, broader, and darker in colour than the ileum.

Operation.

Clearly, this operation should only be done when the stomach is so extensively and generally diseased as to prevent the performance of gastro-enterostomy.

A vertical incision about 2 inches long is made above the umbilicus, and about the neighbourhood of the linea alba. The transverse colon and omentum are drawn up; a piece of small intestine is seized and passed through the fingers until the gut is felt taut at its upper end—that is to say, where it joins the duodenum. A small knuckle of gut in this region is fixed to the margin of the wound with many interrupted sutures, which are passed through the skin and peritoneal and muscular coats of the bowel only. The rest of the abdominal wound is closed in the usual way. In a day's time a small opening is made into the gut.

Memorandum.

Do not make an opening into the intestine larger than will admit a No. 8 catheter. If the opening is larger, food will leak out of the opening in the gut when the patient is fed.

ENTEROTOMY.

This should be resorted to only when a case is desperate—that is to say, too bad for an anastomosis or resection.

An opening is made into the abdomen in such a position as the case may indicate. The first piece of distended small intestine is seized and passed through the fingers so as to obtain a portion as near the cæcum as possible; this is carefully but rapidly stitched up to the incision and then aspirated, or a Paul's drainage-tube is inserted into it. If the case admits, it is better to wait a few hours before opening the gut, for by then the chance of leakage into the abdominal cavity is lessened.

OPERATION FOR INTUSSUSCEPTION.

The abdomen being opened in the usual way over the tumour (if it can be felt from outside the abdomen) the following methods may be tried for reduction or relief:

The method of reduction by manipulation can be performed only when the parts are not gangrenous. The mass, if possible, is drawn out of the abdomen. The intussusceptum being steadied with the left hand, the lower part of the mass, or intussuscipiens, is pulled downwards, and not the upper part, as is too frequently attempted. This traction may be assisted by gently squeezing back the apex of the intussuscipiens with the left hand. If it is impossible to reduce the mass by means of manipulation, any of the following methods may be adopted:

Resection and suture end to end,
Resection and formation of an artificial anus,
Formation of artificial anus without resection,
Anastomosis of part of the gut above to a part below the intussusception.

OPERATION FOR INTESTINAL OBSTRUCTION, THE SEAT OF OBSTRUCTION BEING UNKNOWN.

The cæcum and appendix should be explored first; next the inguinal, femoral, and obturator rings; then the parts in the neighbourhood of the umbilicus. Lastly the pelvis is examined, especially in women. If this search fails to discover the cause, the piece of intestine first presenting itself should be seized and the gut passed through the fingers, first in one direction and, if the cause of obstruction is not met, then in the other. When the piece pulled out of the abdomen has been examined, it is carefully returned. Should the intestines be so distended as not to allow of such a search, a loop of the distended gut may be drawn out of the wound, opened by a longitudinal incision and the contents evacuated. When the gut is empty it is sewn up with Lembert's suture, washed thoroughly, and returned. In this way the great distension may be relieved, and thus a more thorough search facilitated. Should it be necessary, the intestine may be emptied in this fashion by incising in several places.

When the cause of the obstruction has been discovered, it must be dealt with as may be necessary.

CHAPTER III

OPERATIONS UPON COLON

COLON.

Anatomy (Fig. 167).

An account of the general anatomy of the colon will be followed by the particular anatomy as it pertains to the region in which colotomy is done.

The colon commences at the cæcum in the right iliac fossa, and runs up the right loin in front of the right kidney to the under surface of the liver, where it bends (forming the hepatic flexure); thence it passes across the abdomen (about on a level with the umbilicus) to the splenic flexure; it then passes down the left loin to the crest of the ilium, where it forms the sigmoid flexure, and at the upper part of the sacrum becomes the rectum. A feature which distinguishes the colon from any other part of the intestine is the presence of the longitudinal muscular bands. One of these is situated on the anterior part of the colon, a second on the posterior part, and the third along its inner border. Further, the colon has appendices epiploicæ.

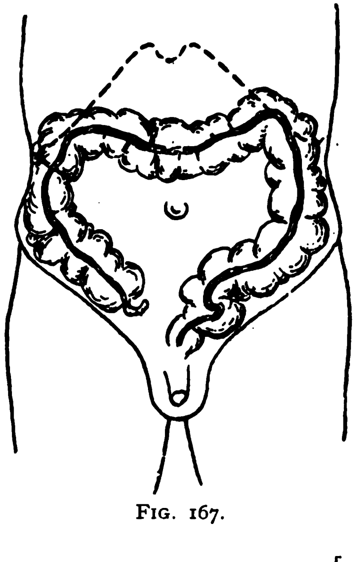

Fig. 167.

COLOTOMY.

Operations.

1. Left inguinal colotomy (Allingham).
2. Right inguinal colotomy.
3. Lumbar colotomy.
4. Transverse colotomy.

1. Left Inguinal Colotomy (Allingham) (Fig. 168).—On the left side of the abdomen an incision is made, with its centre at the junction of the middle and outer thirds of a line drawn from the anterior superior spine to the umbilicus; this incision should be about 2 inches in length and parallel with Poupart's ligament. The abdomen is opened, and the gut sought for. If the large intestine does not at once present in the wound, it must be sought for by tracing the parietal layer of the peritoneum outwards towards the pelvis, when the first thing that the fingers will meet is the sigmoid itself

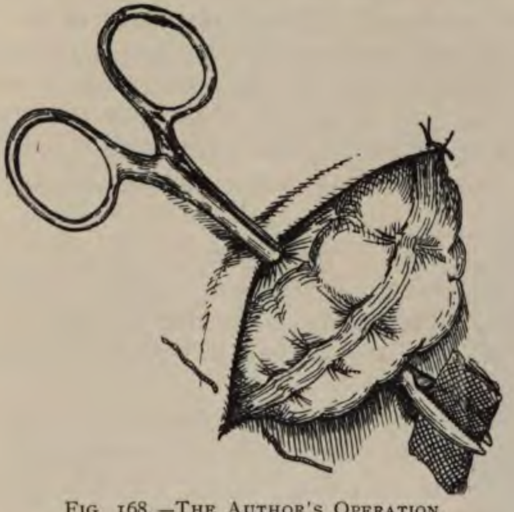

FIG. 168.—THE AUTHOR'S OPERATION.
Showing the clip in place, and one of the end sutures tied and the other ready to be tied.

or its mesentery. Having drawn out a loop of gut, it must be carefully examined to make certain that it is colon and not small intestine; the presence of the muscle bands and the appendices epiploicæ makes certain that the operator is dealing with large gut. A Spencer Wells clip (closed) is then pushed through the mesentery close to its attachment to the gut, avoiding any large vessels; a piece of gauze or drainage-tube is then caught in the blades of the clip to prevent it coming out again accidentally. The clip rests on the skin and prevents the gut falling back. A few stitches are now inserted to unite the skin with the peritoneal and muscular coats of the gut. One such stitch should be placed at either end of the incision, and one or two other stitches may be inserted where it is thought desirable. The gut is opened at the end of twenty-four or forty-eight hours by cutting into it transversely, and at the end of ten days the clip should be removed by completely dividing the gut.

Memoranda.

I. The incision need not be longer than 2 inches. When opening the peritoneum, make sure that no other deeper structure is included in the forceps and thus cut together with the peritoneum.

II. If there is any difficulty in finding the gut, the finger should be passed down to the rectum and the latter traced up, or a finger should be passed up to the kidney and to the descending colon, and this be traced down.

III. If there is any distension of the belly, or if the skin wound has been large, more stitches are necessary in order to prevent the small intestine or omentum prolapsing between the sewn-up gut and the wound edges.

IV. Be careful not to perforate the bowel when putting in the stitches—that is to say, not to wound the mucous coat.

Right Inguinal Colotomy.

The incision in the belly wall is made in a similar position to that on the left side. The cæcum is found and carefully stitched to the margin of the skin wound, the stitches being only passed through the peritoneal and muscular coats. The gut is opened in twelve hours or later, as the case may indicate.

Memorandum.

As there is no necessity for a spur being obtained in this region, it is not requisite to pull up a loop of gut or to put a clip through the mesentery.

Lumbar Colotomy.

Anatomy (Fig. 169).

The space for the operation is limited above by the last rib, below by the crest of the ilium. The distance between these structures varies in different subjects.

To mark out the colon a point is taken ½ an inch posterior to the mid-way point between the anterior superior spine and the posterior superior spine of the ilium; a line drawn vertically upwards through this point indicates the position of the colon in the loin. The external oblique muscle and the latissimus dorsi are the first muscles met with in the operation, the fibres of the external oblique running downwards and forwards. Behind, the fibres of the latissimus dorsi run directly downwards. Next is exposed the internal oblique, whose fibres run upwards and forwards, the posterior fibres almost directly upwards. The next structure is the lumbar fascia, which might be termed the tendon of the tranversalis abdominis muscle; a few of the posterior fibres of this muscle are exposed where they arise from the fascia. These fibres have a transverse direction. When the transversalis muscle and its lumbar aponeurosis are divided, the anterior edge of the quadratus lumborum is exposed,

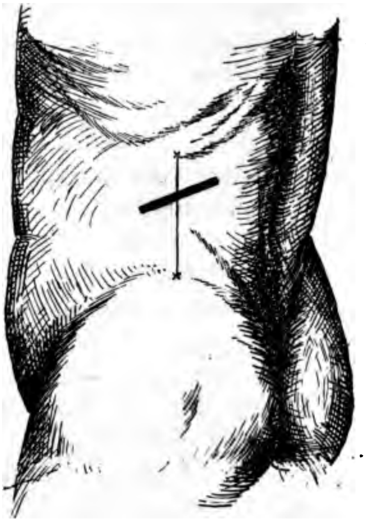

FIG. 169.—THE INCISION FOR LEFT LUMBAR COLOTOMY.

The vertical line indicates the line of the descending colon.

its fibres running directly upwards. Next is reached the transversalis fascia, mixed up with fat, which is at times very abundant. When this has been separated, the colon with the peritoneum is exposed. It is well to remember that the upper part of the colon rests on the kidney.

Operation.

The patient is turned over on to the left or right side, according to the loin which is to be opened. The surgeon stands at the back of the patient, and a firm pillow is placed under the opposite loin. An oblique incision downwards and inwards is made about 3 inches long, with its centre ½ an inch posterior to a point midway between the anterior and posterior spines of the ilium, and midway between the last rib and the crest of the ilium.

The skin and muscles are divided down to the fascia lumborum, which is opened; the anterior edge of the quadratus lumborum is exposed, and partially divided if necessary. The edges of the wound are then retracted, the cellular tissue is torn through, and the back of the colon exposed (uncovered by peritoneum), if it is distended and has no mesentery. Should the colon be collapsed or have a mesentery, it is wise always to turn to the front part of the wound, and deliberately open the peritoneum. A finger is passed into the opening, and the colon is hooked up and pulled to the surface of the wound. If there is a long mesentery and the intestine is on the other side of the abdomen, the skin incision may be enlarged forwards for some inches, and the abdominal cavity opened enough to allow of the insertion of the hand, and thus the colon found and brought to the loin opening. If there is a mesentery, a clip may then be passed through it, as is done in inguinal colotomy. If there is none, the gut must be fixed by interrupted sutures to the edges of the wound. If the introduction of the hand has been necessary, the anterior part of the wound is sewn up as in an ordinary abdominal operation, the gut being stitched to the posterior part of the wound, the sutures only perforating the peritoneal and muscular layers of the intestine.

In twelve hours, or later if there is no urgency, the gut may be opened. If the case is urgent, one of Paul's tubes may be used. This operation is applicable to either loin.

Memoranda.

I. Always be careful to mark out the position of colon, and to begin the incision midway between last rib and crest of ilium.

II. Do not at first make the incision more than 3 inches long, for by limiting the length one is more likely to cut down directly on to the region of the colon.

III. Carefully free the cellular tissue, and if the colon is then not found, deliberately rather than accidentally open the peritoneum and insert the finger to find the colon.

IV. If the colon cannot be found, enlarge the wound forwards and insert the hand into the abdomen to seek for it.

V. Remember that, when the peritoneum has been opened, the large gut is known from the small by its appendices epiploicæ and longitudinal bands, which are never seen on the small gut or stomach.

VI. There is much more likely to be a mesentery to the colon on the right side than on the left.

Transverse or Umbilical Colotomy.

Anatomy.

The transverse colon extends across the abdomen on about a level with the umbilicus, having its fixed points at the hepatic and splenic flexures.

It is attached to the spine behind by the transverse meso-colon. It may be also regarded as being between the layers of the great omentum, which thus attaches it to the lower end of the stomach.

Operation.

An incision is made between 2 to 3 inches long above the umbilicus in the middle line. The abdomen is opened; the omentum is sought for and pulled downwards until the gut is seen. This may be diagnosed by the longitudinal bands, which are not quite so distinct here as in the other parts of the colon, as they are somewhat obscured by the layers of the omentum. A piece of the gut is pulled into the opening and there fixed.

Memorandum.

Make sure that the longitudinal bands are present on the gut, otherwise the stomach may be mistaken for the large intestine, and fixed up in its stead.

COLECTOMY.

This consists in resecting a growth from the large gut through a median or colotomy incision. After the growth has been removed, the upper and lower ends may be stitched to the wound; or the lower end may be sewn up and dropped back into the abdomen; or an anastomosis may be done. When the patient is too ill to undergo any prolonged operation, as resection, etc., the gut, together with the growth, should be drawn through the abdominal wound, fixed in its entirety outside as in an inguinal colotomy, opened above the growth, and drained at once with a Paul's tube. In about fourteen days the mass of outlying gut and the growth are removed, or, if thought wise and possible, the growth can be excised, and the ends of the gut united one to the other and returned into the abdomen.

CHAPTER IV

OPERATIONS FOR HERNIA

INGUINAL HERNIA.

Anatomy.

POUPART'S ligament extends from the anterior superior spine of the ilium to the spine of the pubes. The external abdominal ring is situated immediately above the crest of the pubes. The internal abdominal ring is situated about ½ an inch above the middle of Poupart's ligament.

The inguinal canal is represented by a line joining the internal and external abdominal rings; it is directed downwards and inwards, and is about 2 inches long.

The direction of the deep epigastric artery is represented by a line drawn from the inner border of the internal abdominal ring to the middle of the rectus muscle at about the umbilicus.

The inguinal herniæ may be conveniently divided into two divisions, oblique and direct. The *oblique* passes first through the internal ring, then along the canal, and thus out of the external ring; and the *direct* comes through the external ring without passing through the internal ring or canal. With regard to the coverings of these herniæ, it is important to remember the structures forming the abdominal wall from before backwards. These are:

Skin.
Superficial fascia.
External oblique (about this region called intercolumnar fascia).
Internal oblique (forming the cremasteric fascia).
Transversalis aponeurosis (sometimes).

Transversalis fascia (forming infundibuliform fascia).
Subserous areolar tissue.
Peritoneum.

If these are remembered, the coverings of all cases of inguinal herniæ are known. The only slight difference is that in the oblique or indirect hernia there is no covering from the transversalis muscle. The distinction between these coverings is of no practical value. In operating, an attempt to divide them separately will merely lead to confusion, as they are often matted together.

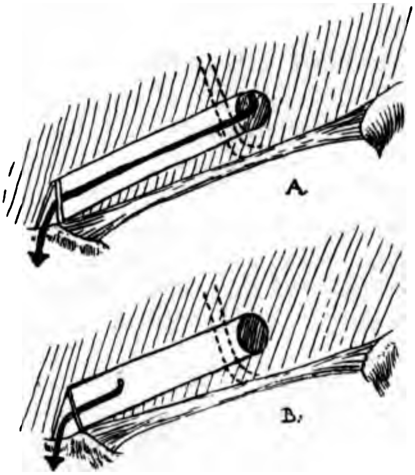

FIG. 170.—DIAGRAMS OF THE INGUINAL CANAL TO SHOW THE DIFFERENCE BETWEEN (A) INDIRECT HERNIA AND (B) DIRECT HERNIA.

The dotted line marks the position of the deep epigastric artery, and the black arrow the direction in which the hernia passes. In B it comes straight through the posterior wall of the inguinal canal.

The only one of the structures that requires further description is the peritoneum, as its arrangement gives rise to various subdivisions of inguinal hernia, such as infantile, congenital, acquired, etc. These it is necessary to explain, as indicating the various seats of strangulation of the gut.

In the descent of the testicle the latter drags a process of peritoneum down with it through the internal ring, and along the canal through the external ring into the scrotum (see Fig. 171, A) What usually happens is that the upper part of this process becomes obliterated, forming the funicular process (as Fig. 171, B). If this process remains patent, it forms what is known as a congenital hernia (as in Fig. 171, A). Sometimes it is only partially occluded by a diaphragm, and a hernia may burst through the diaphragm or be pushed down behind the patent funicular process, so forming an infantile hernia (Fig. 171, C). If another piece of peritoneum is pushed forwards (as in Fig. 171, D), an acquired hernia is formed.

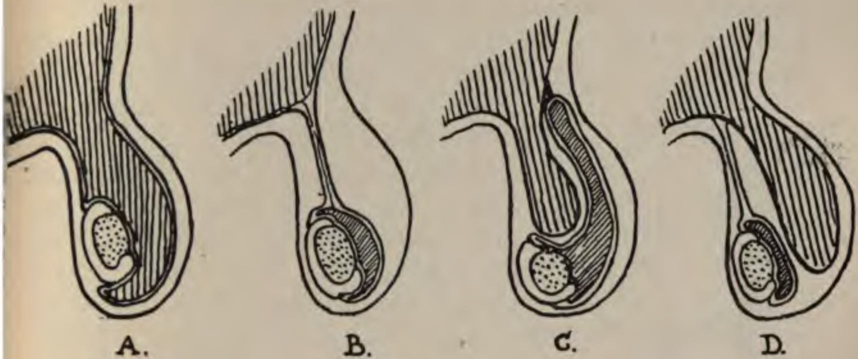

FIG. 171.
A, Congenital hernia; B, normal condition, with obliterated funicular process; C, infantile hernia; D, acquired hernia.

OPERATION FOR STRANGULATED INGUINAL HERNIA.

The patient lies on the back and the surgeon stands on the side to be operated upon. An incision is made about 3 inches in length in the long axis of the tumour. The centre of the incision should be over the position of the external abdominal ring. The skin and cellular tissue are divided, and any superficial vessels are clipped with forceps; the different layers of the structures covering the hernia are divided upon a director, which is passed under them. If the surgeon prefers, the structures may be divided with the knife without the use of a director until what appears to be the sac is reached. This may be recognised by seeing fluid below if the sac is thin, or by its bluish colour. When the sac is reached, if possible it should be examined with the thumb and finger to ascertain if any structure beneath is fixed to it, and also to feel its thickness; then with a pair of forceps it is picked up and opened with a knife, the blade being held horizontally, and dividing the sac close on to the forceps. When the sac is opened fluid often runs out; blunt-pointed scissors may then be introduced, and a sufficient opening made to allow of the insertion of the finger. The finger serves as a guide to the scissors for dividing the sac both upwards and downwards to the extent of the wound. The contents of the sac are then revealed, and if any omentum is discovered, it is separated from the sac, and is held up out of the way. The gut is seen, and the finger passed down to the seat of constriction. Then, with the nail of the left forefinger against the gut, and the pulp of the finger turned upwards and resting on the stricture (Fig. 172), a *hernia knife* is passed along the pulp of the finger on the flat, and very carefully inserted under the stricture. Thereupon the blade is turned round—that is to say, with its cutting edge upwards—and the stricture is divided in an ***upward*** direction. The knife is once more turned so as to rest flat on the finger and withdrawn. Sometimes it is difficult to define the edge of the stricture with the finger; when this is the case, a broad, flat director is put under it, and the knife passed along that, and thus the constriction is divided. The loop of the bowel should be slightly drawn down for the purpose of examining the state of the seat of constriction, and if this is found to be healthy the gut is reduced. Reduction is most easily effected by attempting to return one end of the gut, and, if that fails, by turning to the other end and trying that. The finger is next passed through the internal ring to make sure that all the gut has been reduced. The omentum is then attended to. If it is healthy it is returned, or it may be ligatured in a mass, or tied in pieces and removed.

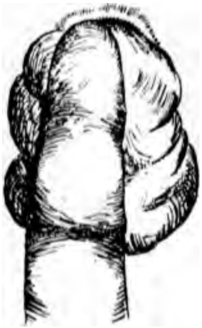

FIG. 172.—DIAGRAM TO SHOW THE METHOD OF PASSING THE FINGER DOWN TO THE STRANGULATING RING.

The intestine is shown behind the finger.

If the patient is in a very bad state, the sac may be left or only ligatured at its neck, and the superficial wound sewn up. If the patient is in a good condition, one of the radical cures presently to be described may be performed.

Memoranda.

I. Make the superficial incision as much in the abdominal wall as possible rather than in the scrotum, as it is then further away from the chance of septic infection.

II. Remember that the sac may be adherent to the omentum, or that there may even be gut within the latter; therefore in opening the sac be careful not to wound any deeper structures.

III. The seat of the stricture may vary. It may be at the internal ring—the usual place, about the canal, or at the external ring, or even in the scrotum in cases of infantile or congenital herniæ. Moreover, there may be two seats of stricture; therefore make certain, by passing the finger into the ring, that all constrictions have been relieved.

IV. In dividing the stricture, always cut upwards, for fear of wounding the deep epigastric artery.

V. When ligaturing the omentum, transfix it, and always tie very tightly. Do not cut it away too close to the ligatures, for fear of it slipping.

FEMORAL HERNIA.

Anatomy (Fig. 173).

The femoral ring, through which the hernia comes, is situated under Poupart's ligament, and may be marked out by finding the pulsation of the femoral artery; half an inch to the inner side should be allowed for the femoral vein, and next to this is the femoral canal. The femoral ring is bounded by:

Above.

Poupart's ligament.

Outer Side.

Femoral vein.

Inner Side.

Gimbernat's ligament.
Conjoined tendon of inferior oblique and transversalis.

Below.

Pectineus muscle and pubes.

There are also important structures directly in relation with the ring on its inner or abdominal aspect.

The spermatic cord in the male is just above the upper border of the ring. To its upper and outer part is the deep epigastric artery, and from this artery is given off a small pubic branch, which passes around the upper margin of the ring and ramifies over Gimbernat's ligament. In one out of three cases the obturator artery arises from the deep epigastric artery, and may pass along the outer side of the ring or along the upper edge, and even down its inner side.

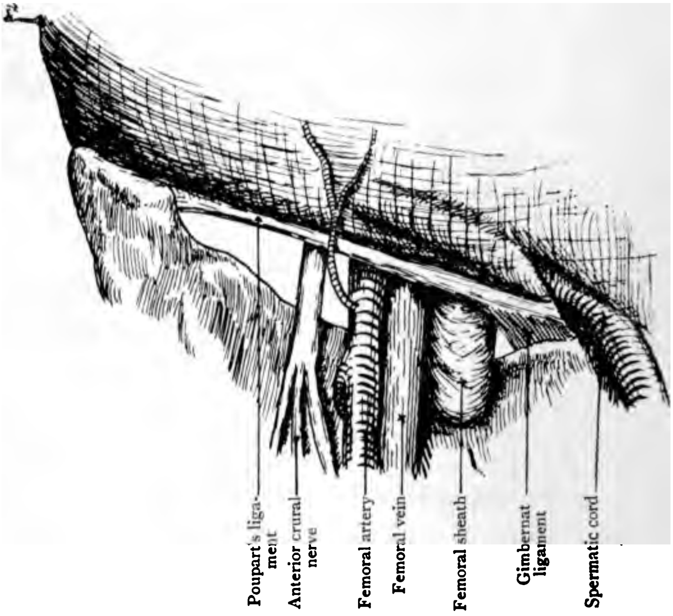

FIG. 173.—DIAGRAM OF THE FEMORAL SHEATH AND ITS RELATIONS IN THE MALE.

The peritoneum covering in the abdominal aspect of the femoral ring, when pushed downwards into the thigh, goes into part of the sheath of the femoral vessels—that is to say, to the inner side of the vein. This part of the femoral sheath is called the crural canal. The crural canal ends in the saphenous opening (formed by the splitting of the fascia lata of the thigh) just below the inner third of Poupart's ligament, and about 1½ inches below and external to the spine of the pubes.

To begin from without inwards, the coverings of a femoral hernia are:

Skin.
Superficial fascia.
Cribriform fascia.
Cellular tissue in canal (called the septum crurale).
The subserous areolar tissue and peritoneum.

Operation for Strangulated Femoral Hernia.

The patient lies on the back; the surgeon, standing on the side to be operated upon, makes a vertical incision about 2 inches long over the tumour, a little on its inner side. The skin and cellular tissue being cut, the fibrous structures which form the sac are carefully divided, or the layers may be divided on a director. The sac on being reached is picked up, and care is taken not to have any of the deeper structures included in the forceps. The sac is opened by the knife, which is held horizontally; the opening having been enlarged upwards and downwards, the contents of the sac are examined; any omentum is then pulled out of the way, and the finger passed down to the constriction. The hernia knife is passed along the finger and inserted under the stricture, and a very small nick made in a direction upwards and inwards. If there is any difficulty in passing the finger-nail under the stricture, a director may be inserted, and the hernia knife passed along that. The gut is then slightly drawn down for the purpose of examining the seat of constriction, and, if healthy, is reduced, and the finger passed through the ring to make sure that this has been thoroughly done. The omentum is cut away, the stump being carefully ligatured and returned. The next step is to free the sac from the cellular tissue by means of the finger. The neck of the sac is then perforated with a blunt needle on a handle. During this process the left forefinger is kept in the sac upon the femoral ring, to make sure that the gut is in the abdomen and not likely to be damaged. The sac is tied at its neck by a Staffordshire knot, and removed with scissors about ½ an inch from the seat of ligature. The wound is cleansed and sewn up.

Memoranda.

I. Always divide the stricture upwards and inwards, and only slightly, with the knife. If a larger orifice is required, it can be made with the finger.

II. Always draw down the strangulated gut a little way to examine the state of the seat of stricture.

III. When dividing the stricture with the knife on a director, take care that no gut overlaps the director, and thus is wounded.

OBTURATOR HERNIA.

Anatomy.

The obturator foramen is formed by the horizontal ramus of the pubes, and the upper border of the obturator membrane and obturator externus muscle.

It is situated under the pectineus muscle behind, and to the inner side of the femoral vessels, and just to the outer side of the adductor longus muscle.

Operations for Strangulated Obturator Hernia.

1. From the thigh.
2. Through the abdomen.

1. Operation from the Thigh.—An incision is made commencing a little above Poupart's ligament, vertical in direction, and passing through a point midway between the spine of the pubes and the femoral artery.

The skin and soft parts being cut, the saphenous opening about its inner part is exposed, the fascia over the pectineus muscle is divided, and the femoral vessels are then well retracted outwards. The pectineus muscle is torn through in the direction of its fibres; the obturator muscle with its fibres is thus exposed, and probably the sac revealed. This should be carefully opened, and with a director inserted the constriction divided; the gut is then reduced, and the sac ligatured at its neck and cut away.

Memoranda.

I. Keep well to the inner side of the femoral vessels, and retract them outwards.

II. Always divide the constriction either upwards or downwards, for the obturator vessels run vertically either to the outer or inner side of the obturator foramen.

2. Operation through the Abdomen.—The surgeon cuts into the abdomen in the middle line below the umbilicus, and gently draws on the gut strangulated in the obturator canal; the constriction is divided from inside and the gut liberated.

Memorandum.

As the gut may be rotten, great discretion must be exercised in dragging on it.

UMBILICAL HERNIA.

Operation for Strangulated Umbilical Hernia.

A vertical incision about 3 inches long is made over the lower part of the tumour; the parts are divided, and the stretched umbilical scar, which is usually adherent to the peritoneum, is carefully opened and the contents of the sac exposed. Frequently the great omentum lines the sac. The finger is gently inserted between the gut and the wall of the sac until the constriction opening in the abdomen is reached. The hernia knife can then be passed along the finger down to the stricture, which is divided directly downwards or upwards, or in both directions if necessary, in the line of the linea alba. The gut is reduced and the omentum dealt with. The finger should always be introduced into the abdomen, in order to be certain that there is not a further band in the belly constricting the gut. A sponge is then inserted to prevent the bowels from prolapsing. The edges of the ring can be pared (if the patient is well enough to stand this part of the operation), and the fibrous portions sutured together with silkworm gut, the sponge being removed before the sutures are tied up. The peritoneal sac may, if possible, be separated and cut away, and the stump sewn up or ligatured previous to dealing with the fibrous ring.

Lastly, some of the loose skin, which is often of very feeble vitality, may be cut away, and the superficial sutures inserted.

Memoranda.

I. Since the sac, skin, and tissues beneath are, as a rule, all adhering to one another, care must be taken in opening the sac.

II. The great omentum often forms the innermost layer of the sac.

III. The stricture may be at the abdominal ring; but there may also be others between portions of gut, or formed by bands stretching across and about the sac.

IV. If the patient is well enough to endure it, sew up the fibrous ring; if he is too ill, be content to reduce the gut, or even only free its constriction, leaving the gut in the sac and closing merely the skin wound.

TREATMENT OF COMPLICATIONS WHICH OCCUR IN HERNIA CASES.

Adhesions.—Adhesions between the gut or omentum, or the gut or omentum and the sac, must be dealt with as described on p. 230.

Wounds, Ruptures, etc.—These are treated as shown on p. 231.

Gangrene of Gut.—The gut should be resected in the way related on pp. 232 and 241. If, however, the patient is too ill to bear resection, the gangrenous portion must be left in the sac and simply incised. When this is done, care should be taken not to interfere with the seat of the stricture, for the gut will be adherent to the surrounding parts, and any separation allow of extravasation of fæces into the abdominal cavity when the gangrenous gut is opened.

Large Masses of Adherent Intestine.—When it is impossible to separate the coils on account of their firm matting, the stricture must be freely divided, and the mass left in the sac; or it may be expedient to carry the hernial incision into the abdomen sufficiently far to admit of a reduction *en masse* into the belly. The belly wound is then united as after an ordinary abdominal section.

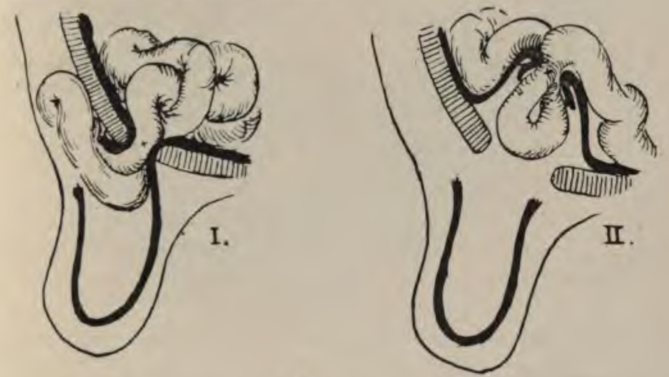

FIG. 174.
In the diagrams the small cross indicates the site of strangulation.

Conditions in which Strangulation may remain after the Gut has been reduced by Taxis (Fig. 174).

1. The sac may be ruptured and the gut turned into the tissue outside the sac (Fig. 174 I.).

2. The sac may be separated at the neck and the gut reduced while still strangulated at the neck (Fig. 174 II.).

3. The sac may be separated from the surrounding tissue and reduced with the gut into the belly. This chiefly occurs in femoral hernia (Fig. 174*a* III.).

4. The sac may have an extra pouch, as in hernia *en bissac*, and the gut be reduced into it while still strangulated (Fig. 174*a* IV.).

The above must be remembered and looked for if there appears to be anything abnormal when the sac is opened, or in those cases in which the testicle is retained in the canal.

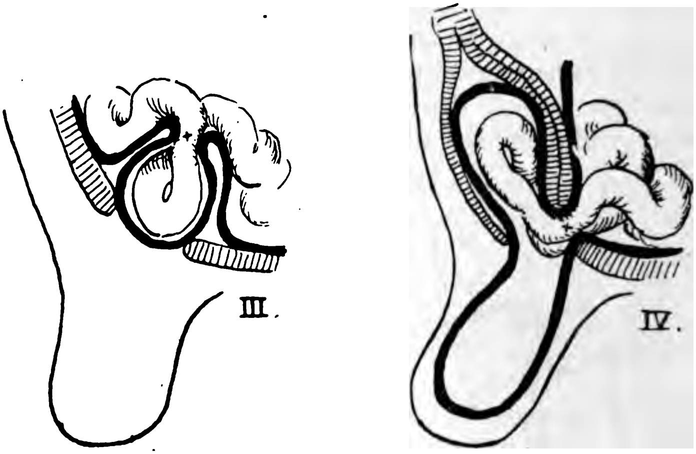

FIG. 174*a*.
In the diagrams the small cross indicates the site of strangulation.

Hæmorrhage from Omentum, Epigastric or Obturator Arteries.—The omentum must be pulled down, if possible, and ligatured afresh. If it has slipped up too high, the hernial incision should be prolonged up into the abdominal wall, and made large enough to admit the hand to reach the omentum and drag it down and secure it.

For epigastric or obturator artery wounds, enlarge the incision upwards through the belly wall, so as to be able to expose the wounded artery and then secure it.

RADICAL CURE OF INGUINAL HERNIA.

Operations.

1. Bassini's (modified by Turner).
2. Barker's.
3. MacEwen's.
4. Ball's.

1. Bassini's Method (Modified) (Fig. 175).—An oblique incision is made over the site of the inguinal canal about 4 inches in length. The external oblique is divided in the line of the skin incision; this will expose the neck of the sac and the internal abdominal ring. The sac is now identified and separated up to the internal ring, special care being taken to free it from the cord. The sac is opened and the contents, if any, reduced into the abdomen (if there is a large mass of omentum it may be ligatured and cut away, and the stump returned). The neck of the sac is tied with silk as high up as possible, a finger being kept in the sac during this manœuvre, and the ligature tied over the end of it; by doing this all danger of including a piece of intestine in the ligature is obviated. The sac is now divided $\frac{1}{2}$ an inch below the ligature, and the distal part removed. The ring and canal are closed by stitching the internal oblique or conjoint tendon down to Poupart's ligament; three or four sutures are inserted with a hernia needle on a handle. In this way the canal is com-

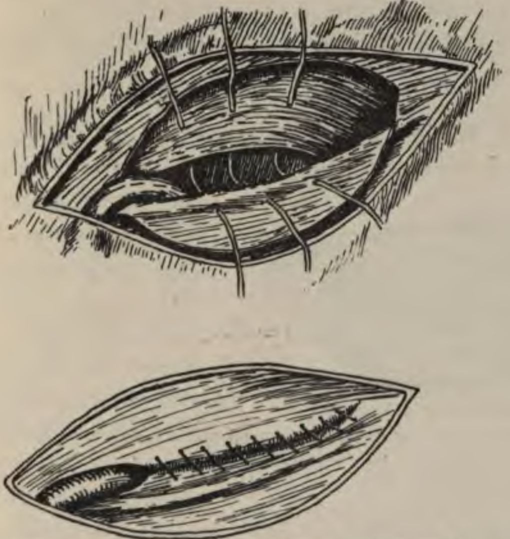

Fig. 175.—Diagram of Bassini's Method (Modified).

The upper drawing shows the sutures in place for uniting the conjoint tendon and internal oblique to Poupart's ligament, and the lower drawing shows the external oblique stitched up with a continuous stitch.

pletely closed, only sufficient room being left below for the cord to emerge. All the stitches must be put in before any of them are tied. The divided edges of the external oblique are united by a continuous suture, and lastly the skin is sewn up.

Memoranda.

I. Isolate the sac carefully and avoid injuring the cord.

II. While passing the deep sutures be careful not to include the cord in them or to injure the femoral vein.

III. Take up plenty of tissue in the deep stitches, to prevent their cutting out.

2. Barker's Method (Fig. 176).—An oblique incision is made, with its centre over the external abdominal ring. The sac is exposed as in any hernia operation, and the neck cleared from the cord. Two silk threads are passed round the sac close to the external ring. The threads are then tied and the sac is cut across between them, its scrotal portion being allowed to drop back into the scrotum. Then one of the ends of the silk attached to the neck of the sac is threaded in a Lister's needle, and this is passed up the inguinal canal in front of the cord, and guided by the left index-finger, which pushes the neck of the sack before it up the canal, and feels for the inner aspect of the abdominal ring. The needle with the thread is then passed through one border of the ring, perforates the abdominal wall, and comes out through the external oblique muscle. The thread is withdrawn from the needle and the latter removed. The needle is next threaded with the other end of the ligature, securing the neck of the sac, and once more passed up the canal, the index-finger being its guide to the

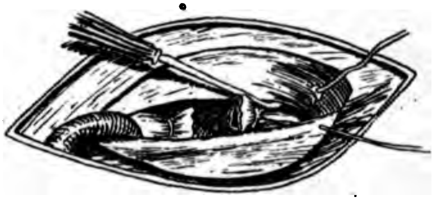

FIG. 176.—BARKER'S METHOD.

The diagram shows the sac divided between two ligatures, and the threads for inverting the upper end of the sac being passed.

opposite side of the internal abdominal ring. In this way the needle pierces the abdominal wall a second time, and emerges at the external oblique, a little way from the seat of puncture of the other end of the thread. These two ends are then tied together as they emerge from the external oblique, the stump during the process of tying up being drawn within the abdomen—that is to say, between the parietal peritoneum and the belly wall. Three or four sutures are passed through the canal and the external ring; the skin is then united.

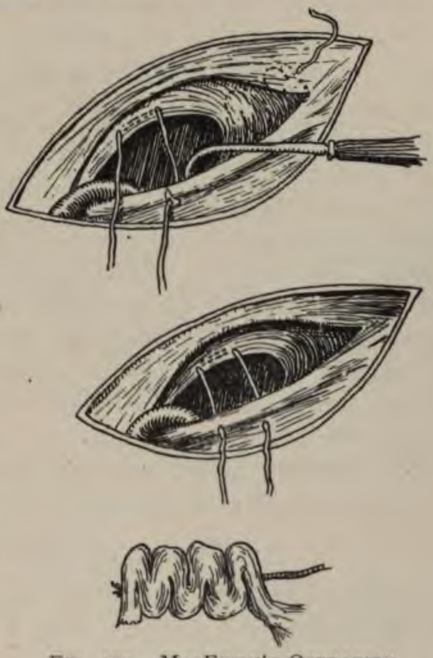

FIG. 177.—MACEWEN'S OPERATION.

The lowest drawing shows the method of puckering the sac, and the upper drawing shows in the dotted outline the puckered-up sac in position.

Memorandum.

Be careful to free the sac from the cord, and not to include the latter in the ligatures.

3. MacEwen's Method (Fig. 177).—In this operation the incision is the same as in the last. The sac is freed from the scrotum and the surrounding parts. It is then pulled down, and the neck separated from the cord and canal. The sac is folded on itself by means of a stitch which is fixed in its lower end; the end of this stitch is then threaded on a needle, and introduced through the canal and abdominal ring. The needle is made to penetrate the abdominal muscles about an inch above the internal abdominal ring; the thread is pulled upon, and thus draws the puckered-up sac into the canal and internal abdominal ring, completely plugging them. The suture is secured by being passed two or three times through the external oblique muscle. The inguinal canal is then closed in the following manner: The finger is inserted along the canal into the internal ring, in front of and above the cord. The hernia needle, threaded, is then passed up the index-finger and made to perforate the conjoint tendon in two places: first, from without inwards, low down, and, secondly, from within outwards, as high up as possible; and the needle is withdrawn. Then the other hernia needle is threaded with the end of the suture coming from the upper perforation of the conjoint tendon, and, being guided by the index-finger into the canal, is passed from within outwards through Poupart's ligament, which it penetrates opposite the lower point of perforation of the conjoint tendon. The needle is next unthreaded and withdrawn. It is then rethreaded, with the end of the suture coming through the lower perforation in the conjoint tendon, and is again passed from within outwards through the transversalis and oblique muscles at a point on a level with the upper stitch of the conjoint tendon. The two ends so passed are then tied up lightly.

The pillars of the external ring may be united, if necessary, with a suture. The skin wound is then closed.

Memoranda.

I. Before tying the suture, see that the cord is not unduly pressed upon or constricted.

II. Move about the superficial skin incision so as to facilitate the passage of the needles and sutures. By this a great deal of the sewing is rendered subcutaneous.

4. Ball's Method.—The sac being exposed, it is isolated up to the ring, and twisted by catch forceps about three or four times until it is felt to be tight. With the twist maintained, a ligature is placed around the twist and cut short. Two sutures are then passed through the skin ½ an inch from the edges of the wound, through the outer pillar of the ring, through the twisted sac in front of the first suture, and then through the inner pillar of the ring and skin. The sac is cut off on the distal side of these sutures. The ends of the suture passing through the skin and twisted sac are then tied over leaden plates lying at right angles to the wound, which has been previously united.

Memorandum.

Twist the neck of the sac sufficiently, but not so tightly as to rupture it.

General Memoranda.

In congenital cases there is often great difficulty in separating the sac from the testicle. When this is so, divide the sac just above the testicle and deal only with its upper half.

Sometimes, even in acquired cases, it is difficult to separate the sac. This is overcome if the peritoneal layer forming the sac is separated alone. Frequently an attempt is made to deal with the tissues covering the sac, rather than with the sac alone. The sac by itself exists separately; if any other coverings are included, the process of separation is very difficult, and at times even impossible.

RADICAL CURE OF FEMORAL HERNIA.

1. Simple method.
2. Watson Cheyne's method.

1. Simple Method.—Consists in dissecting out the sac, ligaturing it at its neck, and cutting it away, as detailed for strangulated conditions in this species of hernia.

2. Watson Cheyne's Method.—A small flap is dissected up from the pectineus muscle and the fascia covering it. After the sac has been ligatured and removed, the small flap is turned up over the ring and sutured in its new position to Poupart's ligament.

RADICAL CURE OF UMBILICAL HERNIA.

The peritoneal sac is freed and twisted as in Ball's method, or simply ligatured. The edges of the fibrous ring are pared and sutured together, as directed on p. 261.

CHAPTER V

OPERATIONS ON THE STOMACH

Anatomy (Fig. 178).

THE following are the surface markings:

The cardiac orifice is represented on the left side by a spot an inch from the sternum, at the end of the cartilage of the seventh rib. The pylorus is marked out 3 inches below the sterno-xiphoid articulation, just to the right of the middle line. The lower border of the stomach is represented by a line drawn across the abdomen, from the tip of the

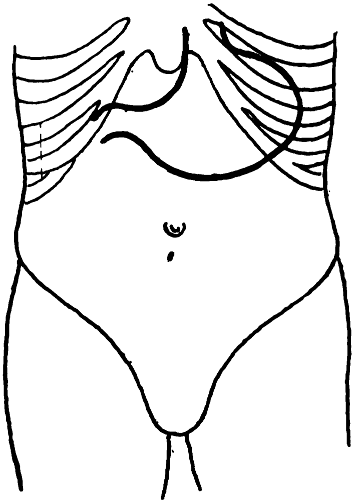

FIG. 178.

The dark outline shows the position of the stomach in relation with the abdominal wall and ribs.

cartilage of the ninth rib on one side to the corresponding spot on the other side. To the lower border of the stomach is attached the great omentum; to the upper border is attached the lesser omentum, uniting it to the under surface of the liver.

Relations of the Stomach.

Above.
Liver, lesser omentum, and diaphragm.

In Front.
From right to left, liver, abdominal wall, and diaphragm.

[Stomach.]

Behind.
Spleen and left kidney.
Transverse mesocolon.
Pancreas, crura of diaphragm.
Greater vessels and nerves.

Below.
Great omentum.
Transverse colon.
Gastro-splenic omentum.

GASTROSTOMY.

Various authors have described different ways of performing this operation, but the following alone need be described:

Operations.

1. Albert's.
2. Witzel's.
3. Fixing the stomach through the interspace between two ribs.

1. Albert's Operation (Fig. 179).—A vertical incision is made about 3 inches in length just below the left rib margin, and about 1½ inches from the middle line; the abdomen is opened, and a pouch-like fold of the stomach is drawn out of the wound. The base of this fold is then united to the parietal peritoneum and posterior sheath of the rectus by a continuous suture. A small incision is now made through the skin just above the rib margin. This must be skin-deep only, and about

2 inches from the first incision. A space is opened through the muscles between this and the first opening, and the pouch of stomach pulled through it. The apex of the stomach pouch is then opened and stitched to the margins of the second incision by four sutures. The first or abdominal incision is now closed in the ordinary way. By this operation a valvular opening is made which prevents the regurgitation of food from the stomach.

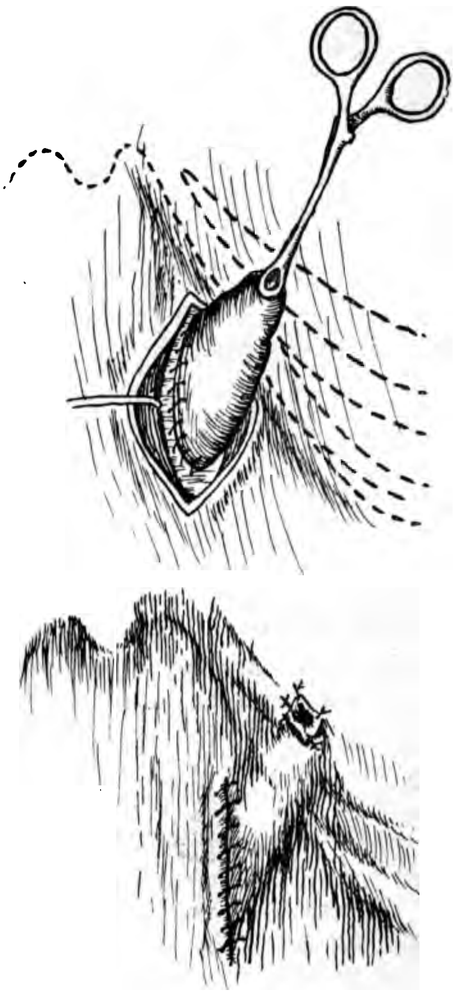

FIG. 179.—ALBERT'S GASTROSTOMY.

The upper drawing shows the pouch of stomach drawn out by a ring clip, and the peritoneum and rectal sheath united by a continuous suture. The lower drawing shows the operation completed and the stomach opened.

Memoranda.

I. Draw the pouch of stomach well out of the wound before commencing to suture it, and see that there is no tension on it.

II. Always find the transverse colon, which can be diagnosed at once by its longitudinal bands; then by tracing it up the stomach is easily found. There is thus no risk of opening any other viscus in the mistaken belief that it is the stomach.

III. Always select a part well to the cardiac end of the anterior wall which is fairly devoid of vessels.

2. Witzel's Operation (Fig. 180).—An incision is made as in the previous operation and the stomach exposed. A small opening is made near the cardiac end, and through this the end of a soft piece of rubber tube is introduced. About an inch of this tube is then buried in the wall of the stomach by means of Lembert's sutures. The part of the stomach around the free end of the tube is stitched to the posterior rectal sheath and peritoneum. The wound in the abdominal wall is sutured

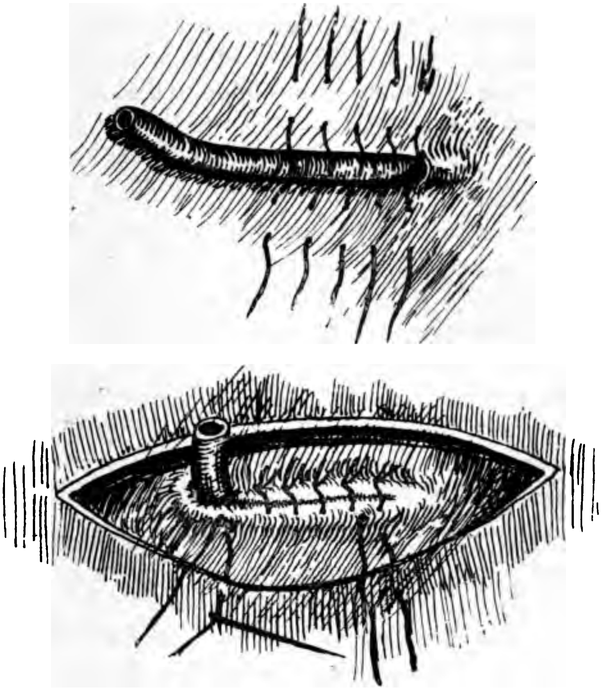

FIG. 180.—WITZEL'S OPERATION.

The upper drawing shows the method of passing the sutures to bury the rubber tube in the wall of the stomach. The lower drawing shows the tube buried in the wall of the stomach, and the stitches being passed to keep the stomach up to the abdominal wall.

up, a space being left for the free end of the tube to emerge, upon which a suitable clip is placed.

3. Fixing the Stomach through the Interspace between the Lower Ribs.—The same abdominal incision is made, the stomach is found, and then, with the fingers of the left hand in the abdomen, the interval between two lower ribs *below the attachment of the diaphragm* is felt for, and the fingers cut down upon from outside. Through this aperture the wall of the stomach is dragged and fixed with interrupted stitches or by hare-lip pins. The abdominal incision is sewn up in the ordinary way.

GASTROTOMY.

A vertical incision may be made as described above, and the stomach is sought for. As much of it as possible is drawn out of the wound and well protected around with sponges. The stomach is then incised. The organ being opened, the finger is introduced into the wound and the foreign body is extracted, or the ulcer or growth explored, and if necessary removed. The wound in the stomach is closed by sutures joining the mucous membrane, and the serous coats are afterwards united by Lembert's sutures. The parts are thoroughly cleansed and returned into the abdomen, the abdominal wall being united as usual.

Memorandum.

Exercise great caution while suturing the incision into the stomach, so that there may be no subsequent leakage.

DILATATION OF THE ORIFICES OF THE STOMACH (LORETA'S OPERATION).

The stomach is previously well washed out. The best incision is one made in the middle line, about 4 inches in length and extending from the ensiform cartilage downwards. The stomach is found in the ordinary way. If it is the pylorus that is to be dealt with, the stomach is incised near it; if the cardiac orifice, the stomach incision is made towards the cardiac end of the organ. The part of the stomach to be incised is brought into the wound and protected with sponges; an incision into the viscus is made just large enough to admit two fingers. The part is steadied with the left hand, and the finger is bored into the orifice and kept there for some minutes until the spasm gives way. By degrees another finger may be inserted, and held there for a time, and, if possible, the fingers are separated, so as to dilate the orifice freely. If it is the cardiac end that is to be dealt with, its orifice is found with the finger, and a dilator—such as Todd's rectal dilator—inserted, and gradually dilatation effected. The wound in the stomach is sewn up, as above described, and the stomach cleaned and returned.

Memoranda.

I. Avoid any large vessels when incising the stomach.

II. Make the incision in the stomach only large enough to admit two fingers, for these will block the orifice, and prevent any stomach mucus, etc., from leaking out.

PYLOROPLASTY.

This consists of bringing the pylorus into the wound, and dividing it along its anterior surface in the longitudinal axis for about 2 inches through the stricture (Fig. 181, I.). The wound so made is pulled apart (Fig. 181, II.)—that is to say, upwards and downwards, so as to make the longitudinal a vertical wound (Fig. 181, III.). The wound is then sewn up in this position, and the pylorus returned to the abdomen.

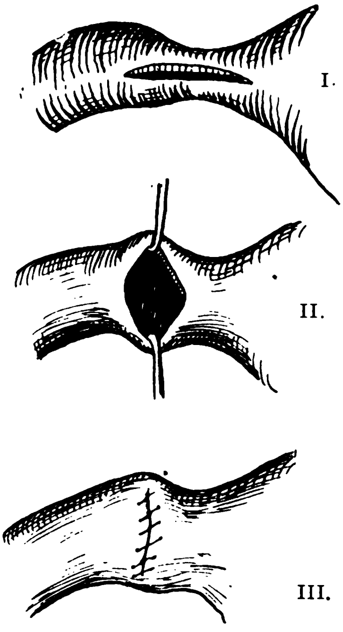

FIG. 181.

RESECTION OF THE PYLORUS.

The stomach is carefully washed out prior to the operation. The surgeon, standing on the right side of the patient, may make one of the following incisions above the umbilicus, selecting the one best suited to the case, viz., *vertical*, through the linea semilunaris or linea alba, or an *oblique* or *transverse* across the abdomen. The vertical is the best if it is practicable—that is to say, if the growth can be easily reached through it. The abdomen being opened, the pylorus is brought as far as possible into the wound, and packed round with sponges. The great omentum is cut through at its attachment to the pylorus, each vessel in it being clipped and secured as divided. This having been done, attention is turned to the lesser omentum, which is treated in the same way. The pylorus is then free, and it is drawn on to the abdominal wall. The stomach and duodenum are then clamped on either side of the growth, the best means of controlling these organs being the fingers of an assistant, or pieces of drainage-tube passed around both organs, pulled tight, and secured with pressure forceps. Attention is then turned to the stomach. This is divided about ¾ of an inch away from the growth. The division of the stomach is made with scissors, and should be carried from the upper border downwards and inwards—that is to say, from left to right—for about three-quarters of its extent. This wound is then closed by Czerny's continuous

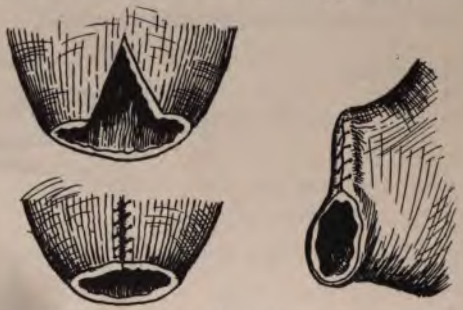

Fig. 182.—Diagram to Illustrate Two Methods of Diminishing the Size of the Stomach Opening so that it will Fit the Duodenum.

suture (for the mucous membrane), and Lembert's for the muscular and serous coats. This being completed, the superficial sutures are left long, for the purpose of controlling the part of the stomach sewn up. The remaining quarter of the stomach is then cut through so as to free it entirely from the pylorus. A sponge is put into the orifice of the stomach to prevent any escape of mucus while the pylorus is being freed from the duodenum; next with scissors the duodenum is cut through about ¾ of an inch from the growth in a direction downwards and to the right, so as to be in the direction of the stomach wound. By this the growth in the pylorus is freed. Lastly, the cut duodenum is united to the orifice in the lower quarter of the stomach. The sponge is removed from the orifice in the stomach, and the stomach and duodenum brought together over a bobbin or button, or by a simple suture. An omental flap is united around the site of union if it is thought necessary and if possible. The abdominal wound is carefully closed.

Memoranda.

I. Have a sufficiently large abdominal wound, and place it as best suited to the case.

II. Carefully pack in sponges behind the pylorus, so as to prevent blood or fluid from finding its way into the belly cavity.

III. If the opening left in the stomach after resection of the growth be too large to unite to the duodenum, it may be reduced by either of the methods illustrated (Fig. 182).

IV. Be careful in dividing the lesser omentum not to injure the hepatic artery, portal vein, or common bile-duct.

GASTRO-ENTEROSTOMY.

Operations.

1. Anterior.
2. Posterior.

1. Anterior Gastro-enterostomy.—The stomach having been previously washed out, the abdomen is opened in the middle line for about 5 inches above the umbilicus. The stomach is found and the anterior wall pulled into the wound. The great omentum is then turned to the right, and the hand, being inserted into the abdomen, catches hold of the first piece of small intestine just below and behind the stomach. This is generally the jejunum. It is passed through the fingers until it becomes taut—that is to say, when it becomes continuous with the duodenum. A loop of this is pulled out of the abdominal wound and emptied of its contents by the pressure of the

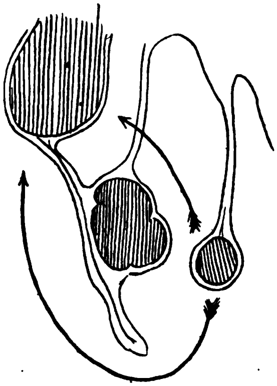

FIG. 183.—DIAGRAM TO SHOW THE ANTERIOR AND POSTERIOR METHODS IN GASTRO-ENTEROSTOMY.

The long arrow shows the route by which the intestine is brought to the stomach in the anterior operation, the short arrow that for the posterior operation.

fingers, and then controlled by a clamp or an elastic drainage-tube placed on each end of it. Sponges are carefully packed in all around the exposed stomach and loop of jejunum. Next, an incision about 1½ inches long is made in the anterior wall of the stomach, a part being chosen which is free from vessels and fairly near to the cardiac end. The same length incision is made into the intestine, and these orifices approximated by the use of Senn's plates, Mayo Robson or Allingham's bobbin, or by a simple suture. A few superficial sutures may be necessary.

Memoranda.

I. Select a loop of jejunum about 12 inches or more from the duodenum and give it a twist, so as to have the peristalsis of the stomach in the same line as that of the intestine.

II. Put in enough sutures, so that there shall be no leaking after the parts are returned into the abdomen.

2. Posterior Gastro-enterostomy by Simple Suture.—After the abdomen is opened, the transverse colon and great omentum are turned up, a small incision is made through the posterior layer of the great omentum, and this incision enlarged by stretching; a pouch of stomach is drawn through this opening and out of the abdomen, and controlled with clamp forceps, the blades of which are protected by rubber. The loop of jejunum is then drawn out and controlled in the same way; a sero-serous suture is next inserted, so as to unite the wall of the stomach to that of the jejunum for about 2 inches, and the suture left long. In front of this line of suture the stomach and jejunum are opened by horizontal incisions, and all the coats of the intestine and stomach are united all round by a continuous suture. This done, the sero-serous suture is completed in front. Lastly, the clamps are removed, and the parts returned into the abdomen.

CHAPTER VI

OPERATIONS ON THE CÆCUM AND APPENDIX

Anatomy (Fig. 184).

THE cæcum is situated in the right iliac fossa. As a rule, it is covered all over by peritoneum except about its posterior part, where it rests upon the loose areolar tissue in the iliac fossa. At times, however, it is wholly covered by peritoneum, and then has a mesentery of varying length. At the lower and inner side it is joined by the ileum, and above, at its upper part, it is continuous with the ascending colon. Attached to its lower and back part is the vermiform appendix. This varies greatly in length and freedom of movement, and has a mesentery. The cæcum possesses the longitudinal bands so characteristic of the large intestine; the anterior band is continued on to the appendix, and acts as a useful guide to that process.

There are also three pouches worthy of note in connection with the cæcum, as the vermiform appendix is at times tucked into them. One, called the subcæcal, is situated under the cæcum; one is at the junction of the ileum with the cæcum, called the ileo-cæcal; and another pouch at the junction of the ileum and the colon is termed the ileo-colic.

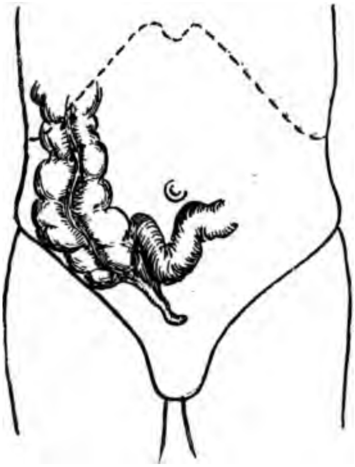

FIG. 184.

REMOVAL OF THE CÆCUM.

This is resected in the same manner as any other part of the intestine. The ileum is cut through and sewn up at its end, and the colon just above the cæcum is also cut through and sewn up. Then the ileum is anastomosed to the colon by cutting holes in each piece of gut some way from the sewn-up ends, and uniting the pieces of gut by bobbins, plates, or simple suture.

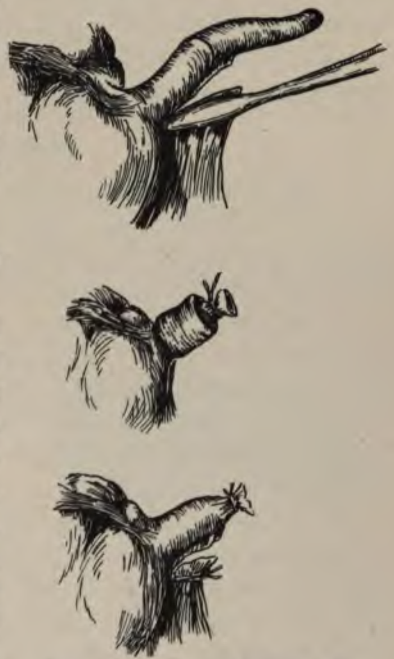

Fig. 185.—Amputation of the Appendix.

In the upper diagram a clip is shown controlling the mesentery, which has been divided, and in the second diagram the sleeve of peritoneum is shown turned back and the appendix ligatured. The lower diagram shows the operation completed.

REMOVAL OF THE APPENDIX (Figs. 185 and 186).

An oblique incision is made over the most prominent part of the swelling, if one is present; if not, it is made over McBurney's spot, which is 1½ inches to the inner side of the anterior superior spine of the ilium. The incision should be about 4 inches in length. The abdominal wall is cautiously opened, and if an abscess is found this must be opened and drained, great care being taken not to break down any adhesions that are shutting off the abscess from the general peritoneal cavity; the appendix if not too adherent should be removed. If there is no abscess, the appendix must be freed by tearing through any adhesions to the surrounding structures. A clip is then placed on the mesentery of the appendix, and the mesentery divided on the side of the clip next the appendix.

A circular incision is now made through the peritoneum covering the appendix, about ½ an inch from the cæcum, and a sleeve of peritoneum turned back. The appendix is ligatured close up to the base of this sleeve, and cut away on the distal side of the ligature. The peritoneal sleeve is then turned back over the stump, and the end held with forceps while it is ligatured. Lastly, the mesentery is ligatured, the clip removed, and the wound closed in the usual way.

Memoranda.

I. The position of the abdominal incision will vary according to the seat of induration; the only point to remember is that it must be made, if possible, outside the line of the deep epigastric artery, so as to avoid division of that vessel.

II. In chronic cases, after removing the appendix, divide any old adhesions in the neighbourhood so as to prevent any chance of after-tendency to intestinal obstruction.

III. Sometimes the appendix is found to be adherent in the neighbourhood of the external iliac vein; great care must then be exercised in separating it.

IV. If the appendix is gangrenous, it is sometimes impossible to turn back a peritoneal sleeve. When this is the case, the stump of the appendix should be inverted into the cæcum, and the walls of the cæcum closed over it by Lembert's sutures.

V. When the appendix is in the subcæcal pouch, it may be necessary to divide the peritoneum passing from the cæcum to the iliac fossa, so as to be able to turn the cæcum inwards, and so thoroughly deal with the appendix and the abscess connected with it.

CHAPTER VII

OPERATIONS ON THE LIVER AND THE GALL-BLADDER

Anatomy (Figs. 186 and 187).

THE landmarks of the liver are as follows: *Above*, its upper margin is marked out about an inch below the right nipple. *Anteriorly*, or below, it projects about an inch below the right margin of the ribs; in the middle line in front it extends downwards to a point midway between the ensiform cartilage and the umbilicus. *Posteriorly* it comes to the surface just below the base of the right lung—viz., about on a level with the tenth dorsal spine. These landmarks apply only to a normal liver, for if it is contracted or enlarged they may vary greatly. The under surface of the liver is of great practical importance with regard to its bearing to the gall-bladder. From the transverse fissure emerge the hepatic ducts, the portal vein, and the hepatic artery. Extending downwards and forwards from it on the under surface of the right lobe is another fissure, in which the gall-bladder rests.

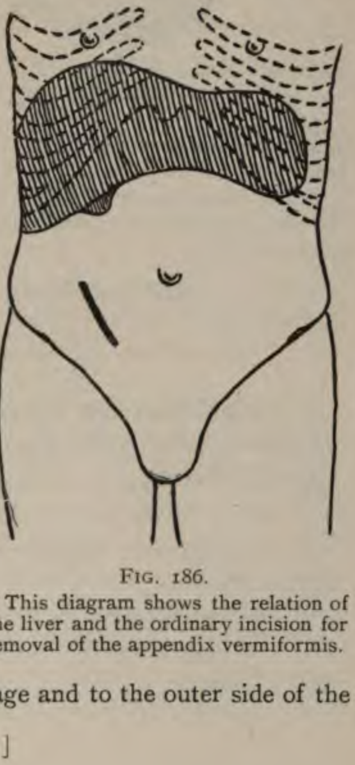

FIG. 186.

This diagram shows the relation of the liver and the ordinary incision for removal of the appendix vermiformis.

The apex of the gall-bladder protrudes immediately below the anterior margin of the right lobe, at a spot marked on the surface of the body opposite the ninth costal cartilage and to the outer side of the right rectus muscle.

The gall-bladder has attached to its upper part the cystic duct; this joins with the hepatic duct, which comes out of the transverse fissure, and the two when united form the common duct. This common duct descends along the right border of the lesser omentum, behind the first part of the duodenum, between the second portion and the pancreas, and passes with the pancreatic duct to open into the second part of the duodenum.

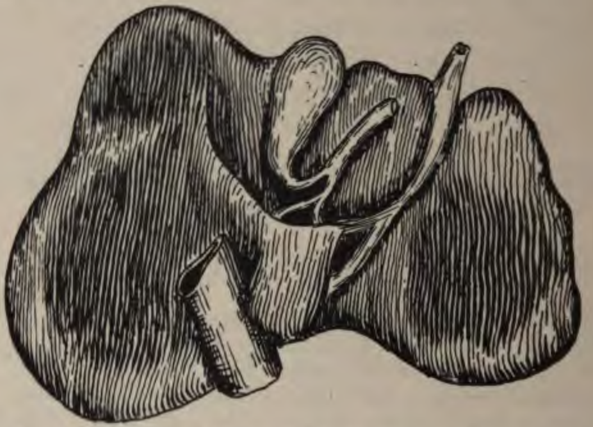

FIG. 187.—DIAGRAM OF THE UNDER SURFACE OF THE LIVER, SHOWING THE ARRANGEMENT OF THE GALL-BLADDER AND BILE-DUCTS.

OPERATIONS UPON THE LIVER.

I. For hydatid cyst.
II. For liver abscess.

1. Operation for Hepatic Hydatids.—Over the most prominent part of the liver tumour, below the lower margin of the rib, a vertical incision about 4 inches long is made through the abdominal wall down to the liver. If there are no adhesions, sponges are packed in around the part to be operated upon. If there are adhesions between the liver and parietal peritoneum, the liver is punctured with a fine trocar, and as much fluid as possible is drawn off. When the liver cyst becomes flaccid, the liver is clipped with clip forceps, and part of it is gently drawn well into the incision in the abdominal wall. Then with scissors the puncture is enlarged and the cysts are cleared out. Lastly, the mother-cyst is very carefully pulled out, and the edges of the wound in the liver are attached to the skin edge. If it is thought wise, this operation may be done in two stages. On one day the abdominal wall is cut through, and with sutures the parietal peritoneum united to the peritoneum which covers the liver. Then in two or three days' time, when the parietal and visceral peritoneum have become united, an incision is made into the liver, the cysts emptied, and the parent cyst removed if possible.

Memoranda.

I. If on opening the abdominal cavity there are found to be adhesions between the parietal and visceral peritoneum, they must not be broken down. The swelling should be opened at once, and when the cyst is empty a few more stitches should be used to unite the edge of the liver to the abdominal muscles.

II. Remember to remove the parent cyst if it is possible.

III. Let none of the hydatid fluid escape into the abdominal cavity.

2. Operation for Hepatic Abscess.—The treatment is exactly the same as for hydatid cysts of the liver. The abscess may be opened at one operation or by the two-stages method, the latter being the safer unless it is found that there are good adhesions between the parietal and visceral peritoneum.

OPERATIONS UPON THE GALL BLADDER AND DUCTS.

Cholecystotomy.
Cholecystectomy.
Cholecystenterostomy.
Choledochotomy.

Cholecystotomy.—The operator standing on the right side of the patient, an incision from 3 to 4 inches long is made in a vertical direction over the most prominent part of the tumour or over the seat of the fundus of the gall-bladder. The peritoneum is opened, and the condition of the gall-bladder carefully noted. The finger is passed up to the transverse fissure of the liver, and the hepatic and common ducts are explored. Sponges having been packed around the gall-bladder, it is aspirated. It is then drawn into the wound and held there with clip forceps and incised, so as to admit the finger to feel for any stones which may be in it. These are removed with the finger or forceps. If any stones are impacted in the ducts, they may be crushed from the outside with forceps surrounded with indiarubber, needled through the ducts, and extracted or broken up with long forceps if within reach. If this is impossible, choledochotomy must be performed. The sponges having been removed, the edges of the gall-bladder are sutured to the parietal peritoneum and to the aponeurotic layer of the abdominal muscles. A large drainage-tube or a gauze drain is introduced into the gall-bladder and brought out of the wound. A few superficial stitches may then be inserted about the ends of the skin wound.

Memorandum.

Before opening the gall-bladder, carefully explore with the finger the hepatic, cystic, and common ducts.

Cholecystectomy.—The abdominal incision is the same as in the preceding operation; the gall-bladder is freed as much as possible from the under surface of the liver, its neck is secured, and then the whole organ is amputated, small flaps of peritoneum being first turned back from its sides. The mucous membrane of the duct is then ligatured, and the small peritoneal flaps are united with sutures over the mucous stump.

Memorandum.

When the gall-bladder has a mesentery, its removal is simple; when it is fixed firmly to the under surface of the liver, great caution is required to separate it.

Cholecystenterostomy (Fig. 188).—This is the operation for uniting the gall-bladder to the intestine for obstruction in the common duct. The abdomen being opened, the outer side of the gall-bladder is exposed, and likewise the ascending or hepatic flexure of the colon. The parts being well protected with sponges, an incision is made into the outer side of the gall-bladder, and another, about an inch long, into the wall of the colon. These are then brought into contact by the use of some bobbin (which must be much smaller than that used in intestinal anastomosis), or they can be joined by simple suture. The skin incision is then united. Sometimes it is more convenient to anastomose the inner side of the gall-bladder to the transverse colon or to the duodenum.

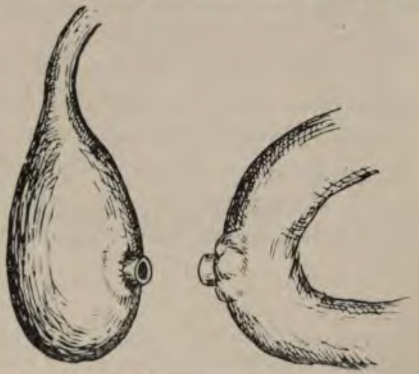
FIG. 188.—CHOLECYSTENTEROSTOMY WITH MURPHY'S BUTTON.

Choledochotomy (Mayo Robson's Operation).—A vertical incision is made over the middle of the right rectus; if this does not give sufficient exposure of the ducts, the incision may be continued up towards the ensiform cartilage. The lower edge of the liver is now dragged up so as to expose its under surface and the gall-ducts. The intestines are kept out of the way in the meantime by a flat sponge. The stone in the duct is cut down upon and removed. The rest of the hepatic ducts are then explored with the fingers, or a probe is passed down to the duodenum from the incision in the duct. The incision into the duct is closed with sutures, a drainage-tube is inserted, and the abdominal wound brought together in the usual way.

Memoranda.

I. Care should be taken to see that the bile fr
does not get into the peritoneal cavity, as it may
and may cause peritonitis.

II. The opening in the duct must not be clos
ducts have been ascertained to be free from all obst

III. This operation is greatly facilitated by pla
bag under the spine about the liver region.

IV. Be careful not to wound the hepatic arte
vein, which are in close relation to the common bil

CHAPTER VIII

OPERATIONS ON THE KIDNEYS

Anatomy (Fig. 189).

THE kidneys are situated in the lumbar region, embedded in fat, and are entirely behind the peritoneum. The upper borders correspond approximately to the eleventh rib behind, and extend down to within 2 inches of the ilium. The right kidney, in consequence of the position of the liver, is a little lower than the left—that is to say, within 1½ inches of the iliac crest. The anterior surface of each organ is covered by peritoneum. The posterior surface rests on a bed of fat and the transversalis and fascia, which separates it from the quadratus lumborum and psoas muscles. At the hilum

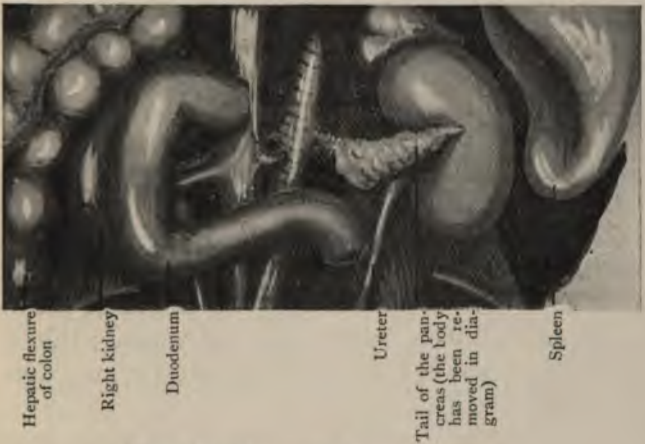

FIG. 189.—ANATOMY OF THE KIDNEYS.

the renal artery and vein enter, the vein being superficial and above the artery. The ureter emerges below, and is posterior to the vessels. The anterior surface of the kidney is in relation in front—on the right side with the liver, duodenum, and ascending colon, on the left side with the stomach, the lower end of the spleen, the pancreas, and the descending colon. The upper part of the kidney is separated by the diaphragm from the pleura; the pleura thus overlaps the upper end of the kidney behind.

Operations.

Nephrotomy.
Nephrectomy.
Nephrolithotomy.
Nephrorrhaphy.

NEPHROTOMY.

The patient is turned on to the sound side, and a firm pillow is placed under the loin so as to make prominent and separate the part to be operated upon. The surgeon stands to the back of the patient, and defines clearly the last rib and the crest of the ilium. Then an incision 3 inches in length is made obliquely about an inch below the margin of the last rib, and extending to within about 2 inches of the spinous processes of the vertebræ—that is to say, the outer border of the erector spinæ. The skin, the external oblique, and the internal oblique muscles are divided until the lumbar fascia and the quadratus lumborum are reached. These are divided to the length of the wound. The perirenal fat then bulges into the wound; this is torn through with forceps or the fingers, the parts are well retracted, and the kidney exposed.

The object of the operation is usually to drain an abscess or cyst. The swelling is punctured, and the opening enlarged with the fingers or dressing forceps. A large drainage-tube is inserted. Should there be severe hæmorrhage from the abscess cavity or cyst, it may be packed with strips of antiseptic gauze, which may be removed in about twenty-four hours.

Memorandum.

Be careful not to wound the large intestine or open the peritoneum, which is just in front of the kidney.

NEPHRECTOMY.

Operations.

Lumbar nephrectomy.
Abdominal nephrectomy.

Lumbar Nephrectomy.—The patient is in the same position as for nephrotomy, and the same incision is made. The kidney is exposed, and it may be found necessary to enlarge the incision still more forwards. If this has to be done, the original oblique incision in the loin is continued forwards and downwards towards Poupart's ligament. All the muscles are carefully divided down to the peritoneum, the peritoneum is then pushed inwards, so as to render the operation extraperitoneal. All superficial vessels being ligatured to get clips out of the way, the edges of the wound are well retracted, and the lower rib held up by the hand of the assistant. With the finger the kidney is separated from its perirenal fat. If the fat is found to be matted together and to the kidney (from inflammation), then freeing it should not be attempted; the thickened tissue should be cut through until the capsule of the kidney is opened and the true kidney structure exposed. Then with the finger the capsule is separated from the kidney proper. The organ is pulled well into the loin wound, and the pedicle is dealt with. An aneurism needle is passed behind the vessels (not including the ureter, which is to be ligatured separately), and is threaded with a stout ligature, and the vessels tied securely as far away from the kidney as possible, so as to leave sufficient space between the kidney and the tied vessels.

The ureter is clamped and divided on the kidney side of the clamp; the renal vessels are also divided with scissors on the kidney side of the ligature. If the ureter is healthy, it may be ligatured and dropped back; if, however, it is diseased or septic, it should be freed and brought into the posterior part of the loin incision, and secured outside the wound there with a stitch for the purpose of drainage. Any small bleeding vessels are then secured, a large drainage-tube or strip of gauze is inserted into the deep parts of the wound, and the superficial wound with the muscles united.

Memoranda.

I. Let the superficial wound be large enough, so as not to drag too much on the wound edges, and also to give a good view of the kidney and its vessels.

II. If there has been much inflammation about the perirenal fat, so that it is bound firmly to the capsule, do not for one moment attempt to separate it. Cut at once into the capsule, and enucleate the kidney therefrom.

III. Ligature securely the renal vessels, using one of the pedicle ligatures described in Chapter I., and always leave a clip on them while cutting the kidney away. Thus, if there is any bleeding, the stump is controlled, and may be easily pulled forwards and the vessels secured again.

IV. When the kidney has to be enucleated from its capsule, there is often not a sufficient length of the vessels exposed to which the ligature can be applied. If this is the case, cut through the kidney, leaving a little of its structure rather than divide the vessels too near to the ligature.

V. Do not use much force in pulling the kidney into the wound, especially when the kidney substance is rotten, as the renal vein may be torn and very serious hæmorrhage result.

Abdominal Nephrectomy (Fig. 190).—The patient lies on the back, and the surgeon, standing on the side from which the organ is to be removed, makes along the linea semilunaris an incision, which extends from the rib above and is carried below the level of the umbilicus, or as far as may be considered necessary. The abdominal cavity is opened, and all bleeding points are secured. The hand is introduced into the abdomen to explore the diseased kidney, and passed across the abdomen to discover whether the other kidney is present, and, if so, whether it is healthy. The small intestines are then pushed to the sound side, and retained there with a large flat sponge. The colon covering the diseased kidney is sought for and pulled towards the median line so as to make its mesentery taut. The outer or upper layer of this mesocolon is then incised and torn open with the fingers in a vertical direction. The soft parts surrounding the kidney are freed, and the organ extracted from its bed of fat. If there has been inflammatory matting of the soft parts, the capsule of the organ is incised and the kidney enucleated therefrom. The renal vessels are then isolated with the fingers, an aneurism needle passed around them and threaded, and the vessels firmly ligatured as far as possible from the kidney. If it is desirable, the vessels may be ligatured before the removal of the kidney from its bed.

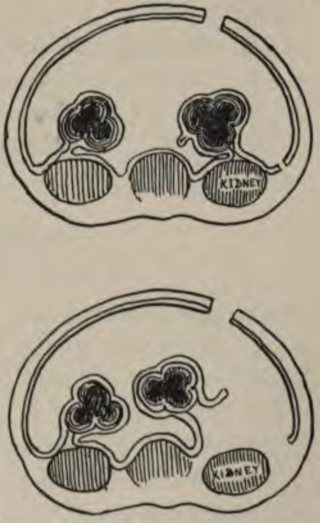

FIG. 190. — DIAGRAM TO SHOW THE METHOD OF REACHING THE KIDNEY IN ABDOMINAL NEPHRECTOMY.

The peritoneum is divided to the outer side of the kidney, and the colon drawn towards the middle line.

Should the ureter be healthy, it is ligatured and dropped back; if diseased, it is brought out at the lower angle of the abdominal wound, or a hole made in the loin and the ureter brought out through it. This latter is probably the better method. If necessary, drainage may be secured by a cut in the loin, or by a tube or gauze brought out at the lower part of the abdominal incision. Lastly, the colon is replaced, and the abdominal wound united.

Memoranda.

I. Make the incision long enough.

II. Always examine the healthy as well as the diseased kidney.

III. Carefully replace colon in position.

IV. See memoranda on previous operation.

NEPHROLITHOTOMY.

Operations.

Lumbar operation.
Abdominal lumbar operation.

Lumbar Operation.—The preliminary stages are the same as in nephrotomy; the only point to be dealt with is the detection of the stone.

The kidney is exposed and the wound retracted. The anterior surface of the kidney and pelvis and the commencement of the ureter are carefully examined with the finger. This search failing, the kidney is well pushed into the loin and its posterior surface is thoroughly explored; further, the thickness of the kidney may be taken between the thumb and finger to discover whether there is any increased resistance at one spot. These methods failing, the kidney is separated from its bed, pulled as much as possible into the wound, and punctured in various directions with a needle; or the posterior margin may be incised, and the finger inserted into the incision, and so into the pelvis, to explore every part of it. If it is desirable, a small sound may be used and each calix sounded.

When by one of these methods a stone has been detected, the kidney is cut into over the stone, which is extracted by the finger, scoop, or forceps. If it is very large, it may be broken up by a lithotrite before removing it. If there is much bleeding, the incision into the kidney is plugged with strips of gauze, which are brought out at the posterior part of the wound and are removed in a few days. The rest of the wound is sewn up in the usual manner.

Memoranda.

I. Always explore the kidney in the order above described.

II. When the stone is detected, cut through kidney structure rather than through pelvis, for a wound in the kidney substance heals more rapidly.

III. When making a hole to explore the kidney with the finger, let it be only large enough to admit the finger, which can then act as a plug while exploring, and so prevent bleeding.

Abdominal Lumbar Operation.—This is really a combination of the abdominal and lumbar methods. An incision is made in the linea semilunaris over the suspected kidney, and should be just large enough to admit the hand. The kidney is thoroughly explored and the stone felt for. If no stone is felt in the suspected kidney, the hand is passed across the belly to the other side, and the apparently healthy kidney is likewise explored. The kidney in which the stone is discovered is pushed well into the loin with the hand in the abdomen, the fingers being kept on the stone. The patient is then brought to the edge of the table and slightly turned on to the sound side. A knife is pushed into the loin, the point being directed towards the fingers of the left hand in the belly which indicate the position of the stone. The incision in the loin is made about 2½ inches long. The finger is passed into the incision down to the stone; the kidney substance is then torn through, and the stone extracted with the finger aided by a scoop or forceps. The abdominal wound is closed and a drainage-tube passed into the opening in the loin.

NEPHRORRHAPHY.

This operation is for fixing a movable kidney. The kidney is exposed from the loin by an incision down to its capsule. Then sutures of kangaroo tendon are passed through the capsule and kidney structure about its upper, lower, and middle parts, and are also made to traverse the aponeurosis and muscles in the wound. They are then tied up tightly and cut short. The superficial wound is united in the usual manner.

Memoranda.

I. Pass sutures well through the capsule and kidney substance, and then through the cut abdominal muscles, and tie up tightly. It is necessary to include all these structures in the suturing, for the kidney is at times movable in its capsule, and at other times the capsule and kidney are movable in the tissues around.

II. In some cases it is a good plan to make a small incision into the abdomen in the upper part of the right linea semilunaris, and then get an assistant to push the kidney well up into the loin, with his fingers in the abdominal cavity. This incision also serves to explore the gall bladder and ducts, which may be the real cause of the symptoms.

CHAPTER IX

OPERATIONS ON THE URETER, PANCREAS, AND SPLEEN

THE URETER.

Operations.

1. Through the peritoneum.
2. Behind the peritoneum.

1. Operation through the Peritoneum.—If a stone is diagnosed to be impacted in the ureter about its centre—that is to say, beyond reach from the kidney or bladder—it may be extracted by means of an incision in the linea semilunaris. The peritoneum being opened and the stone felt in the ureter, the latter is opened in a longitudinal direction and the stone removed. If necessary, the cut in the ureter and peritoneum may be united by a fine continuous suture. After this operation it is well to have for some time a drainage-tube in the peritoneal cavity over the seat of the wound in the ureter.

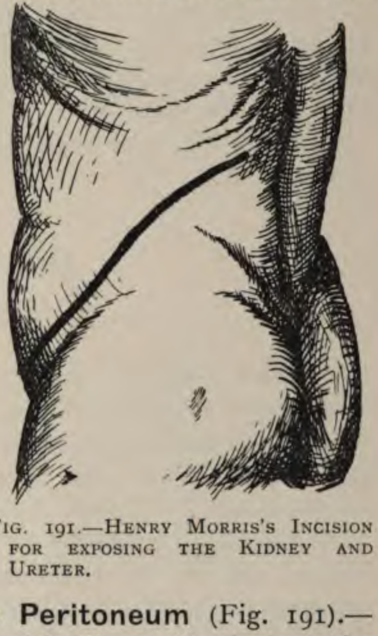

FIG. 191.—HENRY MORRIS'S INCISION FOR EXPOSING THE KIDNEY AND URETER.

2. Operation behind the Peritoneum (Fig. 191).—The following method, as practised by Henry Morris, is by far the better operation: When the kidney has been explored, and it has been found necessary to expose the entire length of the ureter, the original oblique incision in the loin is continued forwards and downwards towards Poupart's ligament about an inch in front of the anterior superior spine of the ilium; through this incision almost the whole of the ureter can be explored from behind the peritoneum, the latter being pushed forward. A stone, if present, can either be removed by pressing it up into the pelvis of the kidney or by making a longitudinal incision on to it, the wound in the ureter being subsequently closed by Lembert's sutures.

THE PANCREAS.

Operation for Pancreatic Cyst.

The abdomen is opened over the cyst, which is drained. It is better to divide the operation into two stages if possible—that is to say, to suture the cyst wall to belly wall—and then open it a few days later. These cysts can rarely be excised, on account of their vascularity and adhesions to deep and important parts.

THE SPLEEN.

Splenectomy.

The best incision is one made in the left linea semilunaris, starting just below the rib margin. The abdomen having been opened and the spleen exposed, the peritoneum over the spleen is stripped off, and the capsule of the organ exposed. The whole spleen is carefully pulled out of the wound, care being exercised not to injure the vessels passing into the hilum during this manœuvre. The best way of dealing with the pedicle is to clamp it close to the spleen, and cut the latter away on the distal side of the clamp. The pedicle should then be transfixed and tied with a stout ligature, the clamp being slowly relaxed while the ligature is tightened. In all its details the operation greatly resembles nephrectomy.

Memorandum.

As the spleen is very friable, great care must be exercised not to tear it before the vessels are secured.

PART VI

CHAPTER I

LIGATURE OF THE ARTERIES OF THE PELVIS

EXTERNAL ILIAC ARTERY.

THE course of the artery is represented by a line drawn from a point about 1 inch below and to the left of the umbilicus to a point midway between the anterior superior spine of the ilium and the centre of the symphysis pubis. The lower two-thirds of this line marks out the artery.

Ligature of the External Iliac.

ANATOMY (Fig. 192).

In Front.
Abdominal wall.
Peritoneum and intestine.
Genito-crural nerve.
Spermatic vessels.
Circumflex iliac vein.

Outer Side.
Psoas muscle.

[Artery.]

Inner Side.
Iliac fascia.
Iliac vein.

Behind.
Psoas.
Iliac vein

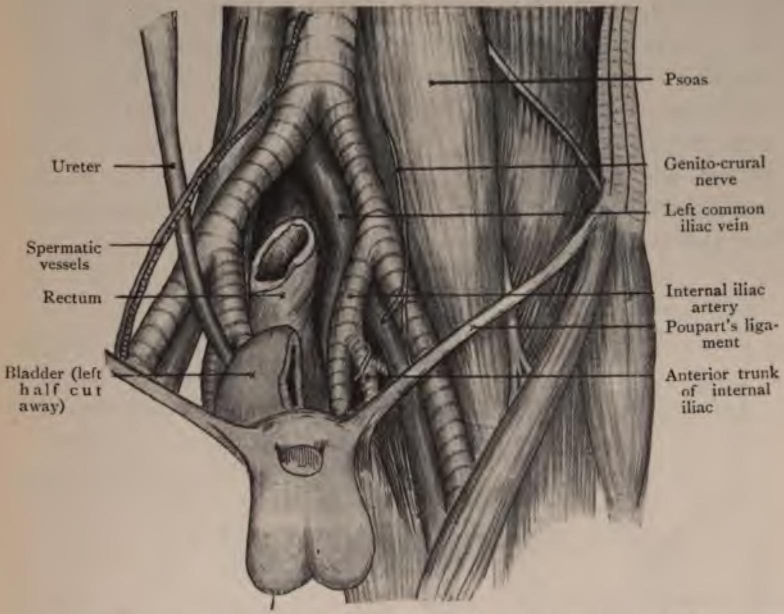

FIG. 192. ANATOMY OF THE VESSELS OF THE PELVIS IN THE MALE.

Operations.

1. Astley Cooper's incision.
2. Abernethy's incision.

1. Astley Cooper's Operation (Fig. 193).—The patient being on the back, the surgeon stands on the side to be operated upon, and makes an incision 3 to 4 inches in length about 1 inch above, and parallel to, Poupart's ligament. The incision is commenced about the centre of Poupart's ligament, and is carried outwards. The skin and fascia being divided, the tendon of the external oblique is exposed. This is divided, and the internal oblique and transversalis muscles are severed until the transversalis fascia is reached. This is opened and divided to the extent of the wound. The subserous areolar tissue is exposed, and is pushed upwards and inwards with the fingers. These structures are well held up with retractors; the artery is then to be felt beating about the inner border of the psoas muscle. It is carefully cleared about 1½ inches above Poupart's ligament, the aneurism needle passed from within outwards and the vessel secured. The peritoneum is allowed to fall back; the divided external oblique, internal oblique, and transversalis muscles may be sewn together with deep sutures, and the skin wound united.

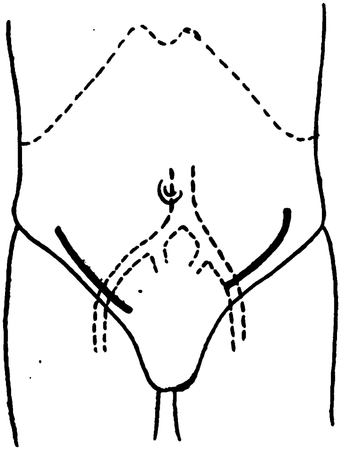

FIG. 193.—LIGATURE OF THE EXTERNAL ILIAC ARTERY.

Astley Cooper's Incision | Abernethy's Incision

Memoranda.

I. Make the incision quite an inch above Poupart's ligament, and commence it on a level with the centre of that ligament.

II. When dividing the transversalis fascia, take care not to wound the deep epigastric artery, which runs from the external iliac artery up between the fascia and the peritoneum in a direction upwards and inwards.

III. Always ligature the artery quite 1½ inches above Poupart's ligament, so as to be well away from the deep epigastric and circumflex iliac vessels, which come off from the artery just above that ligament.

IV. Clear the artery well, so as not to include the genitocrural nerve in the ligature.

2. Abernethy's Operation (Fig. 193).—The only variation in this method is that the skin incision is made differently —viz., 4 inches long, commencing 1½ inches above the inner side of the anterior superior spine, and carried downwards to a point

½ inch above Poupart's ligament, in a line with the vessel. The rest of the operation is done as above described.

Collateral Circulation.

Deep epigastric + Internal mammary, intercostals and lumbar.
Ileo lumbar + Circumflex iliac.
Obturator + Internal circumflex.
Gluteal + External circumflex.
Sciatic + Superior perforating and circumflex.
Internal pudic + External pudic.
Comes nervi ischiadici + Perforating arteries of femoral.

INTERNAL ILIAC ARTERY.

The artery comes off from the common iliac artery opposite the junction of the last lumbar vertebra and the sacrum, and runs down to the upper border of the great sciatic notch. The surface line is about the same as that of the external iliac—viz., two-thirds of the lower part of the line drawn from just below and to the left of the umbilicus to the middle of Poupart's ligament. No very definite line can be drawn, as the artery dips so deeply into the pelvis.

Ligature of the Internal Iliac Artery.

ANATOMY.

In Front.
Peritoneum.
Ureter.
Rectum on the left.

Outer Side.
Obturator nerve.

[Artery.]

Inner Side.
Sacral nerve.

Behind.
Internal iliac vein.
Lumbo-sacral nerve.

Operations.

1. Intraperitoneal method.
2. Extraperitoneal method.

1. Intraperitoneal Method.—The patient is on the back. An incision is made in the linea alba from the symphysis pubis up to or above the umbilicus. The abdomen is opened, and any intestines which are in the way are packed aside with sponges. The common iliac is found and traced down to the internal iliac branch. The peritoneum over the artery is incised, and the artery exposed and most cautiously cleared; the needle is passed and the artery secured. The abdominal wound is then closed.

Memoranda.

I. Raise the pelvis to throw the intestines out of the way. The Trendelenburg position may be adopted with advantage.

II. Always see that the bladder has been emptied.

III. Take care not to injure the ureter, or to include it or the sympathetic nerves in the ligature.

2. Extraperitoneal Operation.—The incision is the same as that for tying the external iliac, except that it is much longer, being continued further outwards. The peritoneum is exposed and pushed up, and the external iliac artery is exposed and traced backwards to the point where it comes off with the internal iliac from the common iliac. Great difficulty is experienced in this operation on account of the depth of the wound.

Memorandum.

Do not mistake the obturator nerve for the artery.

Collateral Circulation.

Branches of internal iliac + Internal iliac of the other side.
Lateral sacral + Lateral sacral.
Sciatic + Internal circumflex.
Branches of deep epigastric + Branches of deep epigastric of the other side.

GLUTEAL ARTERY.

This artery comes off from the internal iliac, passes through the great sciatic notch above the pyriformis muscle, and divides at once into two branches—one running under the gluteus maximus, and a second deeper one between the gluteus medius and minimus. The point where the artery emerges from the pelvis is marked out by a line drawn from the posterior superior spine of the ilium to the top

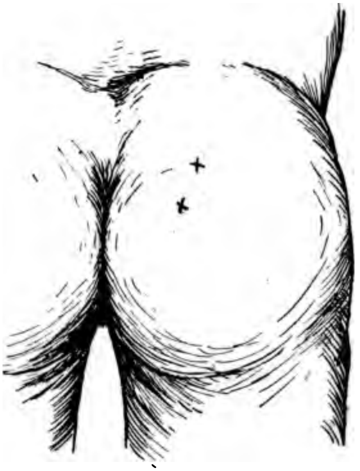

FIG. 194.—DRAWING OF THE BUTTOCK TO SHOW THE POINTS OF EMERGENCE OF THE GLUTEAL (UPPER CROSS) AND SCIATIC (LOWER CROSS) ARTERIES FROM THE PELVIS.

These points are those at which the vessels should be exposed.

of the great trochanter, with the thigh rotated inwards. The point is at the junction of the inner third with the outer two-thirds of this line.

Ligature of the Gluteal Artery (Fig. 194).

Operation.

The patient is turned prone, with the limb to be operated upon hanging over the end of the table; an incision 4 inches long, and enlarged if necessary, is made, with its centre over the point where the vessel comes through the great sciatic notch. The incision is made in a direction downwards and outwards. The gluteus maximus fibres are exposed and separated with the finger; then the gluteus medius is defined, and its fibres are separated from the pyriformis, which is just below its lower edge. These muscles are retracted, the gluteus medius upwards, and the pyriformis downwards. The artery, which is seen emerging from the great sciatic notch, is well cleared, and the ligature applied as far *inside* the notch as possible.

Memoranda.

I. The superficial division of the artery may be met with under the gluteus maximus, and should then be traced up as a guide to the main trunk.

II. Always tie the vessel as far inside the notch as possible, so as to be far enough away from the point at which it breaks up into its two branches, for these are given off immediately on the vessel leaving the notch.

III. Be careful not to include the gluteal nerve in the ligature of the vessel.

SCIATIC ARTERY.

This vessel passes down inside the pelvis to the lower part of the great sciatic notch. It then emerges from the pelvis through the notch and below the pyriformis, running between it and the coccygeus muscle. The point of exit from the pelvis is marked out by a line drawn from the posterior superior spine of the ilium to the tuberosity of the ischium. The site of the artery is at the junction of the lower third with the inner two-thirds of this line. This point also marks the position of the internal pudic artery.

Ligature of the Sciatic Artery (Fig. 194).

Operation.

A vertical incision about 4 inches in length is made, with its centre over the spot marked out. The fibres of the gluteus maximus are divided, the lower edge of the pyriformis is sought for, and the vessel seen coming out from its lower border. This is ligatured as near the pelvis as possible.

CHAPTER II

OPERATIONS ON THE UTERUS AND APPENDAGES

Anatomy (Fig. 195).

THE uterus is situated in the pelvis, being in relation in front with the bladder, behind with the rectum. For practical purposes the uterus may be described as divided into two parts—viz., the body and upper part of the cervix, which are in the abdomen and covered by peritoneum; and the lower half of the cervix, which is in the vagina and not covered by peritoneum. From each side of the upper part, or fundus, of the uterus project the Fallopian tubes, which extend towards the sides of the pelvis. From each side of the fundus of the uterus passes the round ligament. This extends forwards and outwards to the internal abdominal ring, through which it passes down the canal to end in the labia majora.

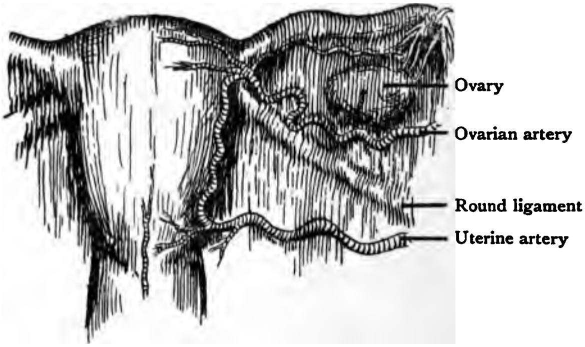

FIG. 195.—UTERUS AND LEFT BROAD LIGAMENT.

The peritoneum of the pelvis may be described as being placed over these structures and tucked down to the bottom of the pelvis, thus forming the depressions between the various organs in the pelvis.

Diagrams 196 and 197 show how the broad ligament is formed. The uterus in the middle and the Fallopian tubes at each side divide the pelvis into an anterior and posterior part, the peritoneum being continuous over the partition. Thus are formed in front the depression between the bladder and the uterus called the vesico-uterine pouch, and behind the depression between the uterus and rectum, here called Douglas's pouch. The reflexion of the peritoneum of the pelvis over the Fallopian tube is called the broad ligament. It is formed by the two folds of peritoneum, which enclose various structures between its layers. Lower down the layers separate, where the peritoneum is reflected over the structures to the front and back of the pelvis.

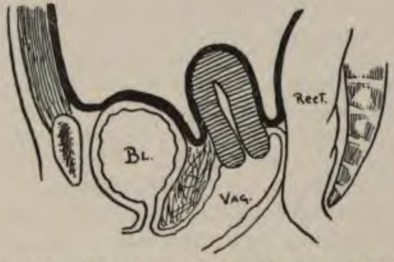

FIG. 196.—DIAGRAM OF THE FEMALE PELVIS IN MEDIAN SAGITTAL SECTION.

The peritoneum is shown by the thick black line.

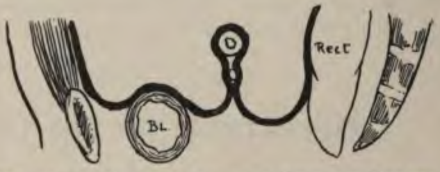

FIG. 197.—SECTION OF THE FEMALE PELVIS PASSING TO ONE SIDE OF THE UTERUS THROUGH THE FALLOPIAN TUBE.

In the upper edge of each broad ligament is the Fallopian tube, attached at its inner end to the superior angle of the uterus, its outer end terminating in the fimbriated extremity, which perforates the peritoneum about 4 inches from the uterus and before the peritoneum reaches the side of the pelvis. The rest of the broad ligament—that is to say, that part between the end of the Fallopian tube and the side of the pelvis—is held up on a level with the Fallopian tube by the ovarian artery (presently to be described), which comes down from the abdomen behind the peritoneum to enter the broad ligament. This part of the raised ridge of the peritoneum is called the infundibulo-pelvic ligament. Below the Fallopian tube and between the layers of the broad ligament are the ovary and its ligament connecting it to the uterus.

The ovarian artery starts from the abdominal aorta. It runs down behind the peritoneum into the pelvis, and then passes abruptly across it, thus forming the infundibuliform portion of the broad ligament. It passes between the two folds of the broad ligament just below the ovary, supplying it and the upper part of the fundus of the uterus. The artery then goes down the side of the uterus to anastomose with the uterine artery, which comes up from below.

The uterine artery arises from the anterior division of the internal iliac artery, and runs downwards and inwards in the pelvic connective tissue behind the peritoneum; when it reaches the cervix it crosses the ureter, and ascends between the layers of the broad ligament along the sides of the uterus, passing up the latter to anastomose with the ovarian artery. In a description of the rough anatomy of the region of the uterus, one must include the course of the ureter. This organ bears an important relation to these structures, and may be wounded (if its position is not appreciated) in some of the operations on the uterus, etc. It comes from the kidneys behind the peritoneum, enters the pelvis, and runs downwards and backwards to about ½ an inch above the spine of the ischium. Here it turns inwards and downwards and forwards, and passes under the base of the broad ligament beneath the uterine artery. It then goes more forwards about ¾ of an inch outside the cervix, passing to the front of that structure. After this it descends along the side of the upper part of the vagina, and turns inwards to enter the bladder.

OPERATIONS ON THE OVARY AND TUBES.

Ovariotomy.
Removal of the Fallopian tubes.

Ovariotomy.

The patient is placed on the back, the operator standing on the right side. The bladder just previous to operation is emptied. The abdomen is opened by an incision, commencing about 3 inches below the umbilicus, and carried down to the upper edge of the symphysis pubis.

The ovarian cyst or solid tumour being exposed, the fingers are introduced into the belly between the mass and the belly wall to discover the nature of the ovarian tumour, and to feel whether there are any adhesions in the neighbourhood of the wound. Sponges are next slipped into the abdomen between its wall and the cyst wall on either side of the wound. If the tumour is cystic it is tapped, and as the cyst becomes empty its walls should be clipped, and gently withdrawn from the abdomen. If there are any adhesions, these are to be dealt with as directed on p. 230.

The cyst or tumour, being completely freed except at its pedicle, is brought out of the abdomen, sponges being packed into the wound to prevent prolapse of the intestines. The pedicle is exposed and spread out with the left hand. A blunt needle on a handle, threaded with silk, is passed through the pedicle between the Fallopian tube and the vessels. The needle is then withdrawn, and the pedicle ligatured by the Staffordshire knot, or by dividing the loop and tying the silk on one side around the Fallopian tube, on the other side around the vessels of the pedicle. The ends of one of these tied threads of silk are cut away, and the other ends are brought around the entire pedicle and tied again. The cyst is then cut away ¾ of an inch from the seat of ligature, and a clip is put on the stump. The object of putting on this clip is to be able to draw the stump into the wound, when the peritoneum has been cleaned, and to ascertain that it is well secured.

The uterus is next felt for and the other ovary examined; if healthy it is left, if diseased it must be removed. The abdominal cavity is cleansed, and all the sponges are removed and counted. With the left hand passed into Douglas's pouch to keep the intestine back, sponges on large clip forceps are passed into the pouch, which is thoroughly swabbed out. If there is much oozing, or if the case has been a dirty one, a drainage-tube or gauze must be passed into Douglas's pouch. The abdominal sutures are inserted in the usual way.

Memoranda.

I. The cyst wall may be adherent to the belly wall in the line of incision, therefore great care must be taken in cutting down on the cyst. If it is adherent, carry the abdominal incision higher up the abdomen to the left of the umbilicus, until the upper part of the cyst is found at a point where it is not adherent.

II. The tumour may be multilocular, and at times solid or semi-solid. If it is multilocular, tap the largest cyst, open the cyst enough to admit the hand into it, and with the fingers burst open the secondary cysts. If the tumour is solid, the abdominal wound must be much enlarged, and the mass delivered.

III. The pedicle may be long or short, or it may be altogether absent, the cyst being between the folds of the broad ligament. When the pedicle is short it must be ligatured with exceeding care; indeed, it may even have to be ligatured in two or three separate portions. When there is no pedicle—that is to say, when the cyst is between the layers of the broad ligament—these layers must be gently split and the cyst enucleated with the hand out of its nest. If in these cases the bottom of the cyst is too adherent to deep structures to allow of removal, the rest of the cyst must be cut away and the very adherent pieces left.

IV. If the cyst is found universally and firmly adherent, the cut edges of the cyst must be united to part of the abdominal incision and drained.

V. Always count the sponges and clips before sewing up the abdominal wound.

VI. Always bear in mind the position of the bladder at the lower part of the abdominal wound.

Removal of the Ovary and Fallopian Tubes.

Operation.

As in the preceding operation, an incision is made in the middle line. The abdominal cavity being opened, the first and second fingers are inserted into the wound, and the fundus of the uterus felt for and traced down to the broad ligament. Then the fingers, being one on each side of the broad ligament, are slipped outwards until the ovary is felt. This is grasped between the fingers and brought to the surface.

The broad ligament is perforated about its inner third, and is tied by the Staffordshire knot or by the double ligature. The ovary and the outer two-thirds of the Fallopian tube are cut away about ½ an inch on the ovarian side of the ligature. The other ovary and tube, if necessary, are removed in like manner.

The above depicts only a very simple case. It must be remembered that the ovary and tube may be greatly matted into the pelvis, and, moreover, the Fallopian tube may also be adherent and full of pus. Then the operation may be most difficult.

Memoranda.

I. If the case is a difficult one, enlarge the incision in the belly wall so as to be able to introduce the hand into the pelvis, and so make out the position of the parts, and separate the adhesions which bind down the Fallopian tube and ovaries.

II. Be careful not to burst a distended tube, for fear of the pus finding its way into the peritoneal cavity. Further, when the tube is collapsed it is much more difficult to distinguish it from the adhesions which bind it down.

OPERATIONS ON THE UTERUS.

Cæsarean section.
Porro's operation.
Abdominal hysterectomy.
Vaginal hysterectomy.

Cæsarean Section.

The patient is in the same position as for ovariotomy. The vagina is well syringed out and cleansed. A median incision is made over the lower part of the abdomen. The belly being opened, sponges are packed between the belly wall and the uterus. The uterus is then rapidly incised for about 4 to 5 inches in a vertical direction; the hand is at once introduced into the cavity, the child's head seized, and the child extracted. The cord is clipped in two places with clip forceps and divided. The uterus contracts forcibly and pushes out the placenta. If this does not take place, the placenta may have to be peeled off the uterine wall, bleeding being controlled with clip forceps. The uterine wall is sewn up with strong catgut sutures, this row including only its muscular walls. Superficial peritoneal sutures are then introduced by Lembert's method, so as to completely bring together every part of the peritoneal covering. The belly is well cleaned and the sponges removed. The abdominal wound is closed as usual.

Memoranda.

I. Prior to operating, diagnose if possible the position of the placenta.

II. Much bleeding from the uterus may be controlled by grasping the neck of the uterus with the finger and thumb. This pressure is maintained until the vessels are secured or the placenta separated.

Porro's Operation.

The incision through the abdominal wall and uterus, and the method of delivering the child are the same as above described. The uterus is then withdrawn from the abdomen, a serre-nœud is applied around the cervix at about the level of the internal os, and the uterus is removed, its stump being treated as described in removing the uterus for tumour (the next operation). The abdomen is cleaned and sewn up.

Memorandum.

The abdominal incision is carried rather lower than in Cæsarean section—that is to say, nearer the pubes, as the stump of the uterus has to be fixed there.

Abdominal Hysterectomy.

Intraperitoneal treatment of the pedicle.
Extraperitoneal treatment of the pedicle.

Abdominal Hysterectomy with Intraperitoneal Treatment of the Pedicle (Fig. 198).—The abdomen having been opened, the tumour is delivered from the abdomen, and the attention of the surgeon is turned to the vessels supplying the uterus—viz., the ovarian and the uterine vessels. The ovarian are found in the broad ligament just below the Fallopian tube and ovary, and are secured with two pedicle clamps. The broad ligament is snipped through from above downwards between the clamps towards the cervix. As the division of the broad ligament is taking place, the round ligaments are also divided and ligatured if there is any bleeding. Next the uterine artery is found close to the neck of the uterus. Through the tissues close to the neck an aneurism needle is passed under the artery, threaded with a ligature, withdrawn, and the artery firmly tied. The artery is likewise secured again a little distance from the first ligature, and it is then divided between the two ligatures. Small anterior and posterior peritoneal flaps are cut from the uterus and turned down; the uterine tissue is cut through on a level with the internal os, and the tumour removed. All bleeding vessels in the stump are then secured;

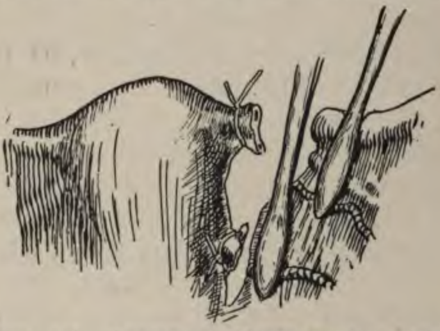

FIG. 198.—ABDOMINAL HYSTERECTOMY WITH INTRAPERITONEAL TREATMENT OF THE PEDICLE.

This shows Spencer Wells' clips placed on the broad ligament as it is being divided, and controlling the ovarian and uterine vessels. The vessels on the uterine side are here shown controlled by ligatures, but they can be equally well controlled by clips.

the mucous membrane of the cervical canal is sutured, and the two peritoneal flaps are carefully united over the stump. The uterus and tumour having been removed, attention is now turned to the clamps; a stout silk ligature is placed around each clamped portion and tied up tight. The divided edges of the broad ligaments are united one side to the other with a few stitches. The belly is cleaned out and the abdominal incision sewn up.

Memoranda.

I. It is better to control the vessels by clamps than by ligatures before removing the uterus, as otherwise, when the uterus is cut away, the ligatures are very apt to slip off owing to the relaxation of the tissues resulting from the removal of their attachment. In tying off each part of the pedicle after the uterus has been removed, let the assistant relax the clip slowly while the ligatures are being tightened.

II. When securing the uterine vessels near the cervix, be most careful not to include the ureter in the ligature or clamp, as it may lie close to the vessels at the seat of ligature.

III. Before severing the uterus from its neck, always remember to control the stump with a clip; otherwise it may slip back into the pelvis before all the vessels are secured, and before the peritoneal flaps are united over the raw stump.

Abdominal Hysterectomy with Extraperitoneal Treatment of Pedicle (Fig. 199).—The abdomen being opened as usual by an incision 4 or more inches long, the hand is introduced and the tumour delivered, the intestines being kept back by sponges. The neck of the uterus is investigated, and the position of the tubes and ovaries made out. The wire of a serre-nœud is put round the neck of the uterus about on a level with the internal os, and below the ovaries and tubes, and tightened up. Spencer Wells' pedicle pins are then passed through the neck of the uterus on the *distal* side of the wire of the serre-nœud, in a transverse direction to the abdominal wound, and about 1 inch apart. The uterus and tumour are cut away about $\frac{3}{4}$ of an inch above the pins. The stump, together with the pins and serre-nœud, is then well pushed into the lower angle of the abdominal wall, the pins and serre-nœud being outside the abdominal cavity. The abdominal wound is carefully united by separate sutures, the one near the pedicle passing also through some of the peritoneum of the cervix, so as to insure the union of the parietal peritoneum to the cervix. Instead of using a serre-nœud, a piece of strong rubber tube may be tied tightly round the neck of the uterus, behind the pins. If this is done, the rubber tube must be tightened up again after the uterus has been cut away.

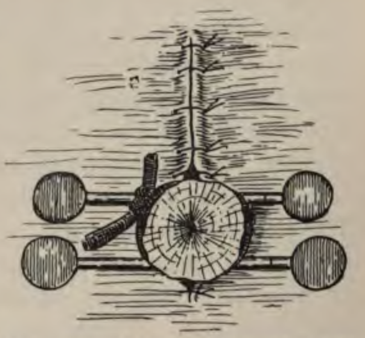

Fig. 199.—Diagram showing the Wound closed after Abdominal Hysterectomy with Extraperitoneal Treatment of the Pedicle.

The pins are shown in place, and the rubber tube tied tightly round the pedicle is also shown.

Memoranda.

I. Place the serre-nœud on a level with the internal os and below the ovaries and tubes. If it is impossible to include the ovaries and tubes in the wire, remove them separately if diseased.

II. When putting on the serre-nœud, take care that no part of the bladder is included in it. Pass a sound if doubtful of the exact position of the bladder.

III. If the neck of the uterus is short, a neck must be figured out of a part of the lower portion of the tumour.

IV. Take care that the wire of the serre-nœud surrounding the neck of the uterus is between the layers of the belly wall when the belly is sewn up—that is to say, above the parietal peritoneum, and lying between the abdominal muscles.

Vaginal Hysterectomy.

The patient is placed in the lithotomy position, the legs being supported and separated by a Clover's crutch. The operator sits in front of the patient, who is brought well to the edge of the table. The vagina having been washed out, a Sims's speculum is passed into it, and is held backwards by an assistant. The anterior lip of the os uteri is grasped with a vulsellum, and the uterus drawn down until the os is brought as near the vulval orifice as possible. The os is next pulled backwards by the assistant. The vaginal mucous membrane is then cut through with scissors along its anterior reflexion on to the cervix. A catheter is passed into the bladder, and by means of the fingers and scissors the uterus is separated from its cellular connection with the bladder. The peritoneum must not be opened at this stage of the operation. The speculum is removed, and the posterior lip of the os is seized with the vulsellum, and drawn well downwards and forwards. Thereupon the vaginal mucous membrane is divided along its posterior reflexion on to the cervix. This separation uniting with the anterior separation, the cervix is freed from its vaginal attachment and Douglas's pouch is opened. Next the operator passes his left forefinger through the hole in Douglas's pouch over the fundus of the uterus, until the point of the finger presses on the reflexion of the peritoneum from the bladder on to the uterus; this piece of peritoneum is divided with scissors. By this time the uterus is entirely free, except at its lateral connections with the broad ligaments. It is then grasped at its fundus with a vulsellum, and pulled through the opening in Douglas's pouch. The broad ligaments are gripped close to the uterus with broad pressure forceps, transfixed from behind forwards outside the pressure forceps, and tied in two portions. While the threads are being tied the pressure forceps are relaxed. The broad ligament is severed close to the uterus on the uterine side of the ligatures. The opposite ligament is next dealt with.

The uterus now comes away. The parts are thoroughly inspected, and the ligatures on the broad ligaments cut short and any other small vessel secured. Lastly, the vagina is carefully plugged with iodoform gauze.

Memoranda.

I. Always have a silver catheter in the bladder, so as to be able to know the proximity of that viscus.

II. When separating the cervix from the vagina, both anteriorly and posteriorly, keep the scissors very close to the uterus.

III. When separating anteriorly and posteriorly, take care not to interfere with the broad ligaments.

CHAPTER III

OPERATIONS ON THE BLADDER

Anatomy (Fig. 200).

THE bladder is covered by peritoneum that comes off the anterior abdominal wall on to the fundus of that organ, and covers the apex and the posterior surface as far as the base of the trigone, where it is reflected on to the vagina in the female, and the rectum in the

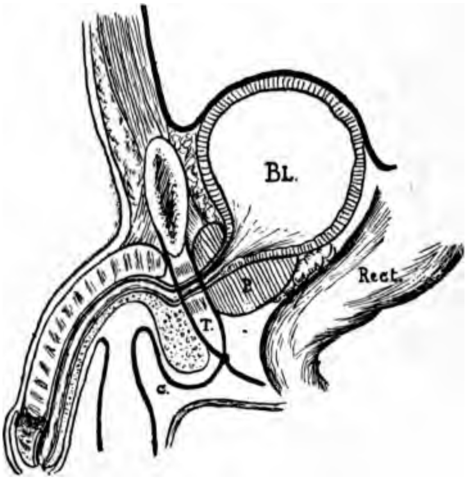

FIG. 200.—SAGITTAL SECTION OF THE MALE PELVIS TO SHOW THE BLADDER AND URETHRA AND THEIR RELATIONS.

The peritoneum is shown by a thick black line.

Bl = bladder; P = prostate; T = triangular ligament: both layers are shown joining together at the lower edge; C = Colles's fascia, joining with the triangular ligament behind, and continuous with the scrotal fascia in front.

male. The anterior wall of the bladder uncovered by peritoneum is joined to the symphysis pubis by loose connective tissue, which allows the bladder to move freely.

Surrounding the neck of the bladder in the male, and placed about 1½ inches below the pubis, is the prostate gland. The prostate rests on the rectum, and can be easily felt 1½ to 2 inches from the anus.

Many operations on the bladder are performed within the perineum and ischio-rectal region, and therefore this region requires description.

The outlet of the pelvis is bounded in front by the pubes, behind by the tip of the coccyx, on each side by the ramus of the pubis and ischium and the tuberosity of the ischium and great sciatic notch. The space for practical purposes may be divided by a transverse line drawn between the anterior part of the tuberosity of the ischium on each side in front of the anus. The posterior half, which contains the anus and ischio-rectal fossæ, will be described later on. The anterior part, or perineum, must now occupy attention.

The superficial layer of the *superficial fascia* of the perineum is continuous with the superficial fascia in other parts. The deep layer of the superficial fascia is attached on each side to the ramus of the pubis, and is continuous in front with the fascia of the scrotum, and connected behind with the posterior edge of the triangular ligament. Beneath this structure and superficial to the triangular ligament are the transverse perineal muscles, the accelerator urinæ, the erector penis muscle, the urethra and its bulb.

The anterior layer of the *deep* perineal fascia is attached above to the anterior edge of the symphysis pubis, on each side to the ramus of the pubis, and behind joins with the deep layer of the triangular ligament, deep fascia, and the deep layer of the superficial fascia. Beneath this is the membranous urethra surrounded by the compressor urethræ muscle.

The posterior layer of the triangular ligament (or deep fascia) is attached above to the posterior edge of the symphysis pubis, on each side to the ramus of the pubis and ischium, and behind unites with the lower border of the anterior layer of the deep fascia and the deep layer of the superficial fascia. Behind this is the prostate gland, and on the inner side of the pubis and ischium are the internal pudic arteries.

Operations.

Suprapubic cystotomy.
Lateral cystotomy.
Perineal median cystotomy.
Litholapaxy.

Suprapubic Cystotomy.

The patient lies on the back; the buttocks are slightly raised, so that they are higher than the chest. This allows the intestines to fall away from the pelvis. The bladder is washed out, and filled with a weak antiseptic lotion, which varies in amount from 10 to 15 ounces. The bladder is then felt as a hard round tumour bulging above the pubis into the abdomen; an indiarubber drainage-tube is put around the penis and clipped, so as to press on the latter and prevent any escape of the fluid. An incision about 3 or 4 inches long is made in the middle line, its lower end being just over the pubis; the muscles are exposed, separated, and the transversalis fascia reached. This is divided and the cellular tissue over the front of the bladder separated. The peritoneum, if it is seen, is gently pushed up to the upper angle of the wound and held out of the way. The bladder is fixed and held up by a sharp hook. It is next opened with a knife for about an inch in length. As soon as the opening is made into the viscus, which may be told by the fluid issuing therefrom, the sides of the incision are clipped with pressure forceps so as to command the bladder. The finger is introduced and the organ explored, or an ordinary Fergusson's vaginal speculum may be passed through the wound into the bladder, and through it the interior of the bladder examined.

If the opening in the bladder is too small, it is enlarged by cutting downwards with scissors. If it is a stone that requires removal, it is extracted with the fingers or lithotomy forceps. If there is a villous growth, it is twisted off or clipped away with Thompson's forceps. If an ulcerated patch has to be treated, it is scraped with a Volkmann's spoon, or dealt with as best indicated. Bleeding occasioned by any of the above proceedings may be stopped by washing out with hot water and touching the part with perchloride of iron, or washing the bladder out with a solution of nitrate of silver and then neutralizing this with a salt solution. The wound is then closed with sutures, which include skin, muscles, and bladder on both sides of the wound. A drainage-tube is inserted into the bladder, and is left projecting from the lower angle of the wound.

Memoranda.

I. When cutting down on the bladder remember that the peritoneum may project lower down than is usual on the anterior part of the bladder.

II. Before opening the bladder always secure it, for as soon as the viscus is opened and empty it will tend to fall back into the pelvis.

III. Do not forget to remove the tube fastened round the penis.

IV. If desired, the rectal bag may be used, as well as dilatation of the organ. Some surgeons keep also a sound or silver catheter in the bladder until the viscus is opened.

Lateral Cystotomy.

The patient is placed at the end of the table, and is held in the lithotomy position by means of a Clover's crutch. The operator sits in front of the perineum. The chief assistant stands to the left of the patient, another assistant steadying the other leg. A curved staff is passed into the bladder and held vertically, with its curve well up against the pubis. The assistant with his right hand securely grasps the staff, and with his left hand holds up the scrotum. The operator inserts the knife, held vertically to the perineum, at a point just to the left of the septum and just behind the central point of the perineum. The knife is pushed in the direction of the staff. It is then carried downwards and outwards for about 3 inches to-

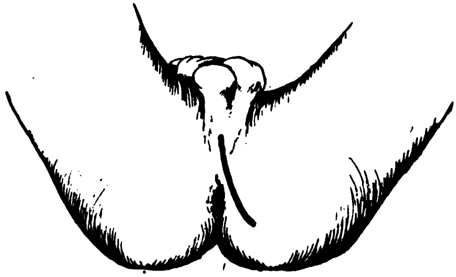

FIG. 201.—THE INCISION FOR LATERAL LITHOTOMY.

wards and into the left ischio-rectal fossa, to a point between the tuberosity of the ischium and the posterior part of the anus. At the upper part of the incision the operator with the left forefinger feels for the groove in the staff. The point of the knife is then inserted into this, the handle being slightly depressed and the cutting edge turned outwards. It is pushed along the groove in the staff into the bladder. The escape of urine, or the feeling of a want of resistance, indicates to the surgeon when the bladder is entered. The knife is withdrawn, and the left forefinger is pushed into the incision along the staff and gently screwed or twisted into the bladder, and that organ explored. When the finger is in the bladder the staff is withdrawn. With the finger the neck of the bladder is freely dilated; when this is done, the lithotomy forceps, held in the right hand, are passed into the bladder and the stone grasped. The finger is withdrawn and the stone extracted gently by a rotating movement. If it is thought wise to drain the bladder, a lithotomy-tube is introduced and tied in.

Memoranda.

I. Have a reliable assistant, who keeps the curved staff well hooked up against the pubis, and does not move it in the slightest or take it away until the finger is in the bladder.

II. Always commence the incision a little below and to the left of the middle line, for fear of wounding the artery of the bulb. Do not cut too far out from, or too near to, the rectum, for fear, in the first place, of wounding the internal pudic artery, and secondarily, which is much more serious, the rectum.

III. Be careful to keep the knife well in the groove of the staff while entering the bladder.

IV. Do not divide the prostate too freely, or push the knife too far into the bladder, and thus wound its posterior wall.

V. Do not use too much force in extracting the stone. Either alter its position in the forceps so as to extract it by its long axis, or with a blunt-pointed bistoury introduced into the wound on the left forefinger slightly nick the prostate.

VI. When one stone is extracted, introduce the finger again to examine the bladder thoroughly, for fear of others being left behind.

VII. In children, on account of the bladder being higher up in the abdomen, take care not to enter the cellular tissue between the rectum and bladder, and so burrow about in this by mistake, thinking that the finger is in the viscus. If too much force is used in dilating the neck of the bladder with the finger, this viscus may be torn from the urethra and pushed away.

Perineal Median Cystotomy.

The patient being in the lithotomy position, a large grooved staff is passed into the bladder, and the curve is made prominent in the perineum by the assistant holding it with the handle towards the abdomen. The first finger of the surgeon's left hand is passed into the rectum and placed on the apex of the prostate, at the same time steadying the staff in the membranous urethra. A straight knife is entered (with its cutting edge turned upwards) at a point about an inch in front of the anus in the median line. The groove in the staff is hit with the point of the knife at about the apex of the prostate, and the knife is made to cut upwards, dividing the urethra. The skin incision and deeper parts are incised for about an inch upwards. A director is passed along the groove in the staff into the bladder. The staff is then removed and the finger gently insinuated through the neck of the bladder into that viscus. The stone is then removed.

Memoranda.

I. Always insert the left forefinger into the rectum, to protect the rectum, to fix and localize the staff, and to fix the apex of the prostate.

II. Unless it is absolutely necessary, do not prolong the incision too far up, for fear of wounding the artery of the bulb. If a larger incision is needed, rather divide the prostate laterally.

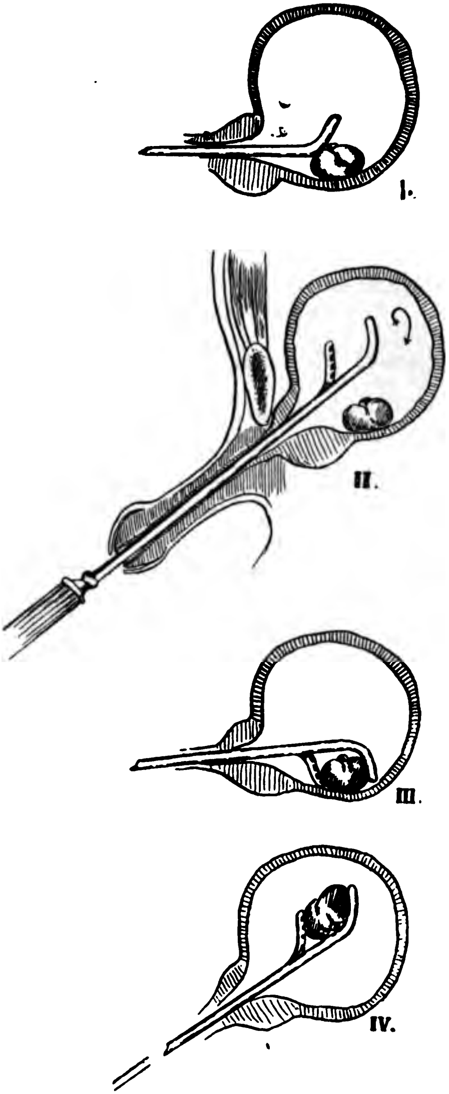

FIG. 202.—DIAGRAMS TO ILLUSTRATE THE METHOD OF USING A LITHOTRITE TO CRUSH A STONE OF MEDIUM SIZE.

I. The lithotrite being used as a sound to locate the stone. II. The lithotrite being opened in the middle of the bladder; the arrow shows the way in which the blades are turned over to grasp the stone. III. Seizing the stone. *IV. Position* for crushing.

Litholapaxy (Figs. 202 and 203).

The patient lies on the back, the buttocks being on a firm pillow, the legs flexed and well separated. The surgeon stands on the right of the patient. About 6 ounces of water or some weak antiseptic solution are introduced into the bladder. The lithotrite is passed with great gentleness, the meatus having been previously split if it is too small to admit the instrument. The beak of the instrument should be allowed to glide gently over the trigone of the bladder so as to detect the position of the stone. The stone being felt to one side of the instrument, the beak of the lithotrite is turned to the opposite side and opened, and when opened is turned over again towards the stone. After this the blades are slowly closed. Should the stone not be caught, the handle of the lithotrite is depressed, the instrument opened again, passed to the base of the bladder, and closed. By one or other of these movements the stone will be grasped. When the stone has been caught in the lithotrite it is lifted to the centre of the bladder. The blades are slowly screwed home and the stone fractured or crushed up, according to its consistency. This done, the lithotrite is returned to the base of the bladder, and any large fragments are caught and crushed again. This is done several times, until all the large fragments are broken up. The lithotrite is then tightly screwed up and withdrawn. An evacuating-tube of the largest size that the urethra will carry is passed into the bladder, and the evacuator attached to it. The fluid is forced into the bladder, and, as it returns through the evacuating-tube, carries away the débris with the outward stream of water. This is repeated slowly several times, a short interval being allowed to elapse between each flow of water into the bladder. If any fragments are

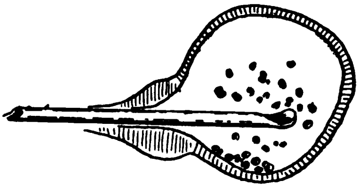

FIG. 203.—DIAGRAM SHOWING THE EVACUATOR IN POSITION AFTER THE STONE HAS BEEN CRUSHED.

felt which are too large to come through the tube, the lithotrite is again introduced and the fragment or fragments crushed until they can be removed by the evacuator.

Memoranda.

I. Introduce the lithotrite very gently, so as not to disturb the water in the bladder, and thus cause the stone to move about.

II. When the stone is seized, carry the lithotrite, together with the stone, to the centre of the viscus, so as to make sure that none of the bladder wall is included between the blades of the instrument.

PLASTIC OPERATIONS ON THE BLADDER.

For extroversion of the bladder.
For recto-vesical fistula.
For vagino-vesical fistula.

Extroversion of the Bladder.

So many operations have been devised that readers are referred to special works on the subject; indeed, almost every case requires its own mode of treatment. A description is here given of Wood's operation, which is perhaps the most frequently employed. An umbilical flap is made square at its base, adjoining and slightly broader than the upper margin of the opening. It should be sufficiently long to cover in the bladder completely when it is turned down over it; a pyriform flap is next dissected up on each side, its breadth being equal to the length of the first flap, and its base downwards and inwards. These two flaps are then drawn across the reversed umbilical flap, meeting in the median line, and are fastened to each other with sutures, which also include a portion of the thickness of the turned-down umbilical flap, so as to keep the raw surfaces in contact. The edges of the gaps left by the removal of the umbilical and lateral flaps are drawn together as well as possible with sutures, hare-lip pins or button sutures being used.

Recto-Vesical and Vagino-Vesical Fistulæ.

These must be dealt with as the case indicates. Some are cured by paring the edges of the fistulæ and carefully suturing others may require some variety of plastic operation.

CHAPTER IV

OPERATIONS ON THE URETHRA AND PROSTATE

URETHRA.

Anatomy.

THE male urethra extends from the neck of the bladder to the tip of the penis. Its prostatic portion is surrounded by the prostate gland. The membranous portion is between the two layers of the triangular ligament, and extends from the apex of the prostate to the anterior surface of the triangular ligament. In front of this is the spongy portion, which extends to the apex of the penis, and is surrounded by the corpus spongiosum.

Internal Urethrotomy.

The patient lies on a firm couch. Two different forms of urethrotome may be used—viz., one that cuts from behind forwards, or one which cuts from before backwards. The preferable method is the first. The position of the stricture being diagnosed, and having been dilated sufficiently to admit a No. 6 English catheter, the urethrotome is inserted into the urethra, and its end passed through the stricture. The little blade in the urethrotome is protruded, and the instrument with the knife out is drawn through the stricture. As soon as it is felt that the stricture is freely divided the little blade is ensheathed again, and the instrument withdrawn.

A No. 12 catheter is next passed, and tied in for twenty-four to forty-eight hours.

Memoranda.

I. Make sure that the urethrotome is through the stricture, and not in a false passage.

II. Always divide the stricture along the floor of the urethra.

External Urethrotomy.

Operations.

Wheelhouse.
Symes.
Cock.

Wheelhouse's Operation (Fig. 204).—The patient is in the lithotomy position. A Wheelhouse's staff is introduced down to the stricture, and is held with the groove towards the perineum. While the assistant holds the staff in position, an incision is made into the perineum in the median line. The tissues of the perineum are divided until the urethra and staff are reached. The knife is inserted into the groove of the staff and the urethra opened. As soon as the urethra is opened and the groove of the staff fully exposed, the edges of the healthy urethra are seized on each side with clips and held apart. The staff is then gently withdrawn until the button point appears in the wound. It is then turned round so that the groove may look to the pubes, and the button is hooked on to the upper angle of the opened urethra, which is then held stretched open at three points. While this is held open, a probe-pointed director is inserted into the urethra, and the point pushed onwards through the stricture towards the bladder. The groove of the director is then turned downwards, and the whole length of the stricture carefully and thoroughly divided.

Next the point of a Teale's probe gorget is introduced into the groove of the director, and, guided by it, passes onwards into the bladder, dilating the divided stricture, and forming a metallic floor, along which the point of a catheter can be guided into the bladder. A catheter (10 to 12 size) is then passed from the meatus down into the wound, and is guided by the Teale's probe into the bladder. The gorget is then withdrawn. The catheter is tied in and allowed to remain for some days, when it is changed and a new one passed.

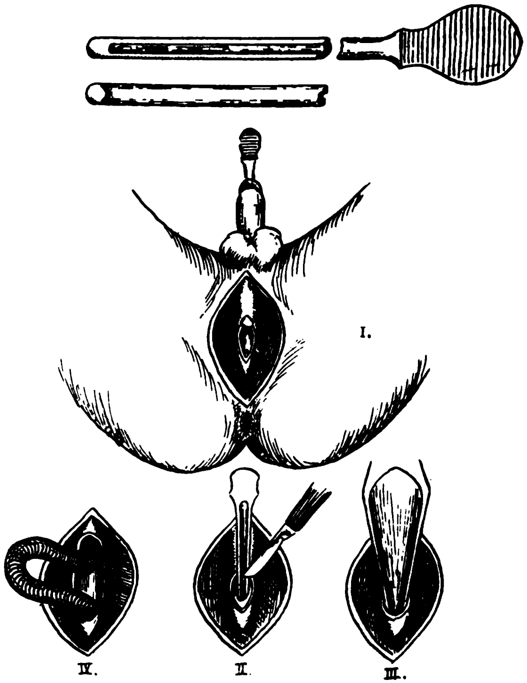

Fig. 204.—Wheelhouse's Operation.

The staff is shown above; it has a groove on one side, and a hook on the other.

I. The urethra opened and the staff turned round so that the hook engages the upper margin of the incision in the urethra. II. The director passed through the stricture, and the latter about to be divided. III. The gorget introduced into the bladder. IV. The catheter being introduced.

Memoranda.

I. Make the skin wound in the perineum long enough.

II. Make sure that the staff is not in a false passage.

III. Do not hurry in the operation. Take time and care to find the way through the stricture into the bladder when the urethra has been opened in front of it.

Symes' Operation.—Symes' staff is necessary for this operation. From the handle to about half its length it is the size of a No. 8 or No. 9 catheter. The remainder is the size of a No. 3 or No. 4 catheter; the lower half of the curve is grooved along the anterior or convex surface. The staff is passed into the urethra, the narrow part passes through the stricture, the shoulder of the large portion resting on the stricture. The surgeon cuts down in the middle line of the perineum on to the point of junction of the thick with the thin portion of the staff. The knife is then entered into the groove of the thin portion of the staff, and is pushed onwards, freely dividing the stricture in its entire extent. A director or Teale's gorget is then passed into the bladder and the staff removed. A catheter is lastly passed from the penis along the gorget or director into the bladder and tied in.

Memorandum.

Be careful that the small portion of Symes' staff is not in a false passage.

Cock's Operation.—This is performed for cases of impassable stricture with the perineum infiltrated with inflammatory material and many fistulæ present. The patient is placed in the lithotomy position, the buttocks being brought well to the edge of the table. The left first finger of the operator is passed into the rectum and placed on the apex of the prostate. The knife is pushed straight into the perineum in the middle line, towards and close to the finger on the apex of the prostate. The external skin incision may be enlarged, but should not come down to a point nearer the anus than ½ an inch. The shape of the wound so formed is triangular, with the apex at the prostate, and the base formed by the skin incision. With the left finger still in the rectum and marking the apex of the prostate, a director is passed into the wound in the direction of the finger, and is made to find its way into the opening in the urethra, and thus into the bladder. A small perineal lithotomy-tube can then be passed along the director into the bladder.

Memoranda.

I. Keep in the middle line, and always pass the knife towards the apex of the prostate.

II. Always insert the left forefinger into the rectum, and never remove it until the director has passed well into the bladder.

III. Remember that, should the urethra be missed, the bladder can always be entered by feeling for the lower edge of the triangular ligament, and pushing the knife straight in just below this point.

PROSTATE.

Anatomy.

The prostate consists of two lateral lobes and a central lobe; the whole is enclosed within a fibrous capsule. The gland surrounds the prostatic portion of the urethra and the neck of the bladder, the urethra being more to the front than to the back of the gland. The gland, as it were, embraces the urethra. According to Freyer, the capsule is somewhat deficient in the central anterior portion, and dips down between the lateral lobes. On each side of the prostate is the prostatic plexus of veins, which drain into the vesical plexus; these veins may be much enlarged in cases of senile hypertrophy of the gland. Some of the anterior fibres of the levator ani also come down on each side of the gland and form a lateral relation. The prostate, besides having a fibrous capsule, has also a sheath formed by the reflection of the pelvic fascia, which splits to surround the organ. The venous plexuses are situated between this sheath and the capsule of the gland. Most of the arteries supplying the organ are also enclosed by this sheath of fascia. The prostate rests in front upon the posterior layer of the triangular ligament, and behind is in relation with the rectum, about 2 inches above the anus.

Operations on the Prostate.

Operations.

Prostatotomy method.
Prostatectomy method.

Prostatotomy.

This consists of removing the obstructing lobe by means of a specially-designed electrode passed *per urethram*, with which the lobe is burned through from behind forwards as the instrument is withdrawn.

Prostatectomy.

Operations.

Suprapubic method.
Perineal method.

1. Suprapubic Method.—A suprapubic cystotomy is performed in the usual way. The mucous membrane over the part of the gland which it is desired to remove is then incised with scissors or scratched through with the finger-nail. With the finger the hypertrophied gland is carefully enucleated from its capsule, and finally, if necessary, snipped away with scissors. The forefinger of the other hand should be inserted into the rectum, to press forward and steady the gland during the process of enucleation. Any bleeding that will not stop with hot lotion can be controlled by packing the bladder, after putting tubes down to the neighbourhood of the ureters.

2. Perineal Method (Parker Symes).—The patient is placed in the lithotomy position. A staff is passed into the bladder, and an incision is made through the perineum, and the whole length of the membranous urethra divided on the staff. The prostate is exposed, and the prostatic urethra dilated sufficiently to admit of the introduction into the bladder of Parker Symes' rubber retractor, which is introduced collapsed, and then distended with water by means of a syringe. With this retractor the prostate is pulled well down into the perineal wound, the fibrous capsule of the gland is incised with scissors, and the gland enucleated with the fingers either whole or piecemeal. The retractor is then emptied and removed, a large drainage-tube put into the bladder through the wound, and the rest of the wound packed with gauze.

CHAPTER V

OPERATIONS ON THE PENIS

Anatomy.

The penis is made up of three portions. The corpora cavernosa are attached by their crura to the ramus of the pubis anteriorly, and terminate in rounded ends, which fit into the middle surface of the glans penis and support it. The corpus spongiosum, which has the urethra running through its entire length, commences posteriorly in front of the deep perineal fascia, and terminates anteriorly in the glans penis. The main arteries of the penis are the arteries of the corpora cavernosa, which run in their substance. There are also the two dorsal arteries, which run along the upper surface of the penis in the groove formed by the junction of these bodies.

Operations.

Circumcision.
Amputation.
Plastic operations.

Circumcision.

A probe is first passed between the prepuce and the glans, and, if possible, the adhesions are broken down. The prepuce is then well drawn forwards and clamped with forceps in front of the glans. The portion in front of the forceps is cut off with a knife or scissors and the forceps removed. It will then be found that the skin has retracted, but the mucous membrane is still seen covering the glans. A director is passed between the mucous membrane and the glans, and the mucous membrane slit up along the dorsum to the corona or base of the glans. The mucous membrane is thoroughly freed from adhesions and cut off around the base of the glans a little distance from the corona. Lastly the mucous membrane and skin edges are carefully sewn together with interrupted sutures.

Memoranda.

I. When the prepuce is pulled forwards, be careful that none of the apex of the glans is included in the forceps and thus cut away.

II. When slitting up the mucous membrane, be careful that the director is not passed into the urethra instead of between the mucous membrane and the glans. Be careful to clip and ligature every bleeding-point.

Amputation of the Penis.

Operations.

Partial amputation (Jacobson).
Entire amputation (Gould).

Partial Amputation of Penis (Fig. 205).—The base of the penis is secured with a piece of drainage-tube so as to arrest hæmorrhage. The surgeon standing on the right of the patient, a narrow-bladed knife is passed between the corpus spongiosum and the corpora cavernosa, and is made to cut forwards and downwards for about 1½ inches. From this small flap the urethra is dissected out up to the base of the flap. A flap of skin is then cut from the dorsum and side of the penis, resembling in miniature the upper skin flap in an amputation. This flap is retracted, and the corpora cavernosa are cut through transversely on a level with the point of the trans-

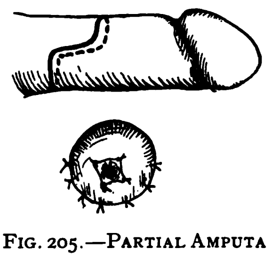
FIG. 205.—PARTIAL AMPUTATION OF THE PENIS.

The lower drawing shows the end of the stump.

fixion. The tourniquet is then relaxed and the vessels are secured. The upper flap is punctured about its centre. The dissected-out urethra is drawn through the hole in the flap, then slit transversely and the edges are sutured to the edges of the hole in the flap. The upper skin flap is united with sutures to the lower skin flap.

Memoranda.

I. Always cut the urethra longer than the corpora cavernosa.

II. Dissect the urethra free from the small posterior flap, and split it transversely after it has been drawn through the hole in the anterior flap. If these precautions are not taken, the urethra may retract and contract, and cause a stricture of the urethral orifice.

Entire Amputation of Penis.—The patient is placed in the lithotomy position. The scrotum is divided along the median line right down to the penis; the halves of the split scrotum are then held apart, and the penis is transfixed far back between the corpus spongiosum and the corpora cavernosa, and the corpus spongiosum cut through. Next the suspensory ligament of the penis and the skin around its base are divided, thus leaving only the corpora cavernosa attached to the pubis by their crura. These are separated from the ramus of the pubis with an elevator, and thus the penis is removed. The urethra is split up a little and attached to the posterior angle of the incision. The wound, including the division of the scrotum, is then sewn up.

Memorandum.

Leave enough of the urethra and corpus spongiosum in front of the triangular ligament to allow of sewing it to the skin at the posterior angle of the wound.

Plastic Operations on the Penis.

Hypospadias.
Epispadias.

Operation for Hypospadias (Fig. 206).—First the penis must be straightened by a free division of the constricting band under the penis. At times, in order to make it straight enough, it is necessary to cut well into the corpora cavernosa. Sometimes two deep transverse cuts are necessary. When the penis is straightened these transverse wounds will become longitudinal, and may be sutured together in this position.

In some months' time the next step in the operation may be undertaken. This is the formation of an urethra, and is done as follows: The penis being held up, vertical incisions are made on either side of the under surface of the penis a little outside the lateral margin of the mucous surface, corresponding to the deficient urethra, and reaching from the glans to the hypospadiac orifice. Transverse incisions are also made at each end of these vertical incisions, and the two narrow quadrilateral flaps thus formed are dissected up towards the middle line. The edges of these flaps are then turned inwards to meet in the middle line; the flaps thus figured leave the mucous surfaces turned in, and the raw surfaces turned outwards. They are then united at their edges, over a catheter, with fine catgut sutures inserted in many places. From the edges of the

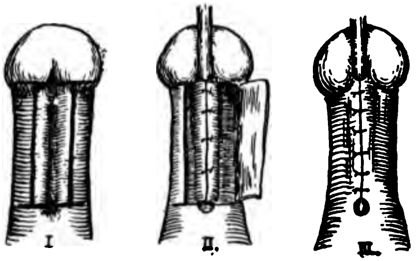

FIG. 206.—PLASTIC OPERATION FOR HYPOSPADIAS.

wounds formed by the dissecting up of the quadrilateral flaps the skin of the penis on both sides is well freed, until the skin flaps thus formed will nearly meet in the middle line without tension over the raw turned-in quadrilateral flaps. The skin flaps are in like manner united in the middle line with fine sutures. As soon as these flaps have well united and the urethra formed, the edges of the posterior end of the new urethra and the hypospadiac orifice are refreshed and carefully united, a catheter being tied in the bladder to drain the urine and prevent it passing along the urethra until it is well healed.

Memorandum.

Many operations or attempts may be required before the entire urethra is made.

Operation for Epispadias.—This may be undertaken in the same way as for hypospadias in all its details. Many operations have been devised, but it is beyond the limits of this work to describe them here.

CHAPTER VI

OPERATIONS UPON THE SCROTUM AND ITS CONTENTS

Anatomy.

THE scrotum contains the tunica vaginalis, which covers the testicle and part of the cord. The cord is made up of the vas deferens, the spermatic artery from the aorta, the artery of the vas deferens from the superior vesical, and the cremasteric artery from the deep epigastric. The spermatic veins commence in the pampiniform plexus, and pass up, entering the inferior vena cava on the right side, the renal vein on the left side. The lymphatics of the testicle enter the lumbar glands, those of the scrotum the inguinal glands.

Operations.

Castration.
For hydrocele.
For varicocele.
Vasectomy.

Castration.

The surgeon grasps the scrotum and the testicle with the left hand, so as to make the tissues tense. A vertical incision is made from about the external ring well down to the bottom of the scrotum. The cord about the upper part of the incision is exposed and separated; it is transfixed with an aneurism needle threaded with silk; the needle is then withdrawn, and the cord firmly tied in two pieces. The ligatures securing one half are cut short, but the ends of the ligature securing the other half are brought right round the cord and tied again. The testicle with its coverings is enucleated from the scrotal skin, and cut away from the cord about ½ an inch on the distal side of the ligature. Vessels in the scrotum are secured, a drainage-tube inserted, and the wound sewn up.

Memoranda.

I. If the skin of the scrotum is involved, remove the diseased skin by an elliptical incision.

II. Be most careful, in ligaturing the stump, to do so effectively, so as to prevent any risk of hæmorrhage when the cord retracts.

III. If the disease extends far up the cord, slit up the inguinal canal, in order to find a sound part to ligature.

Operation for Hydrocele.

This consists of laying open and cutting away with scissors all the tunica vaginalis, except that portion attached to the testicle and the cord.

Memoranda.

I. A drain should be used in these cases.

II. Be careful not to injure the cord; this should be isolated and held out of the way before removing the tunica.

Operation for Varicocele (Bennett) (Fig. 207).

The cord is grasped in the left hand, and the skin over the upper part of the cord made tense; an incision about ¾ of an inch long is then made over the cord, commencing just below the external ring. The sheath of the cord is divided and the veins exposed; the vas deferens is then sought for and carefully isolated. An aneurism needle armed with silk is passed beneath the veins, and the veins are tied firmly as high up as possible; a clip is next put on to the veins ½ an inch below the ligature, and the veins divided between the ligature and the clip. An inch or more of the veins is then separated downwards, and another ligature placed round them at the lowest point. This is tied up tight, and the piece of the veins thus isolated cut away. The two ends of the divided veins are then sutured together. The cord is returned to the scrotum, and the wound in the skin carefully united after all bleeding has been stopped. All the structures except the artery to the vas are divided and removed with the veins.

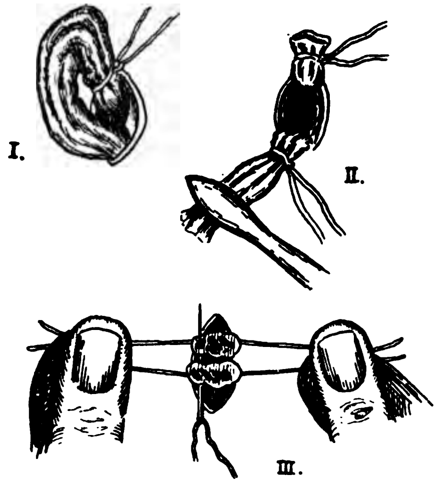

FIG. 207.—OPERATION FOR THE CURE OF VARICOCELE.

I. Cord drawn out, after separating the vas, and ligatured above. II. Veins divided and ligatured below. III. Sewing the ends together.

Memoranda.

I. Always carefully isolate the vas deferens.

II. Ligature the divided ends of the veins most securely, and always leave enough tissue beyond the ligatures. If the structures are cut away too close to the ligatures, they may slip and cause severe hæmorrhage later on.

Vasectomy.

An incision is made in the same way as for the operation for varicocele. The cord is exposed and the vas sought for. It can be recognised by its feel, which is firm and resistant, and by its appearance, which is white and glistening. About an inch of the vas is excised between ligatures, and the wound closed.

CHAPTER VII

OPERATIONS FOR RUPTURED PERINEUM

Anatomy.

The perineum is the part between the vaginal and rectal orifices, and consists of a pyramidal collection of connective tissue. The apex of the pyramid is upwards, between the walls of the rectum and vagina. The perineum acts as a point of attachment for several muscles, the chief of which are the sphincter vaginæ, the external sphincter, and the levator ani.

Many operations have been proposed for the repair of the perineum, but two only will be described.

Operations.

For partial rupture.
For complete rupture (that is to say,
into the rectum).

Operation for Partial Rupture (Fig. 208).

The patient is placed in the lithotomy position; the operator sits facing the perineum. The assistants separate the parts about the vulva with the hands so as to make the perineum taut; the surgeon inserts his left forefinger into the rectum, then with short sharp-pointed scissors splits the remains of the recto-vaginal septum of the perineum transversely. Then one blade of the scissors is inserted at one angle of the transverse cut, and pushed upwards well into the labium majus at the junction of the skin and mucous membrane, and with one cut the tissues are divided. In the same manner the tissues on the other side are divided. These lateral incisions are carried from the extremities of the transverse cut upwards to about on a level with the centre of the vulva. Then, with the fingers, assisted by the scissors, the cellular tissue, opened by these cuts, is torn asunder, so that in the transverse cut the rectum and vagina are separated at their cellular interval, where they rest in contact with one another. The result of this separa-

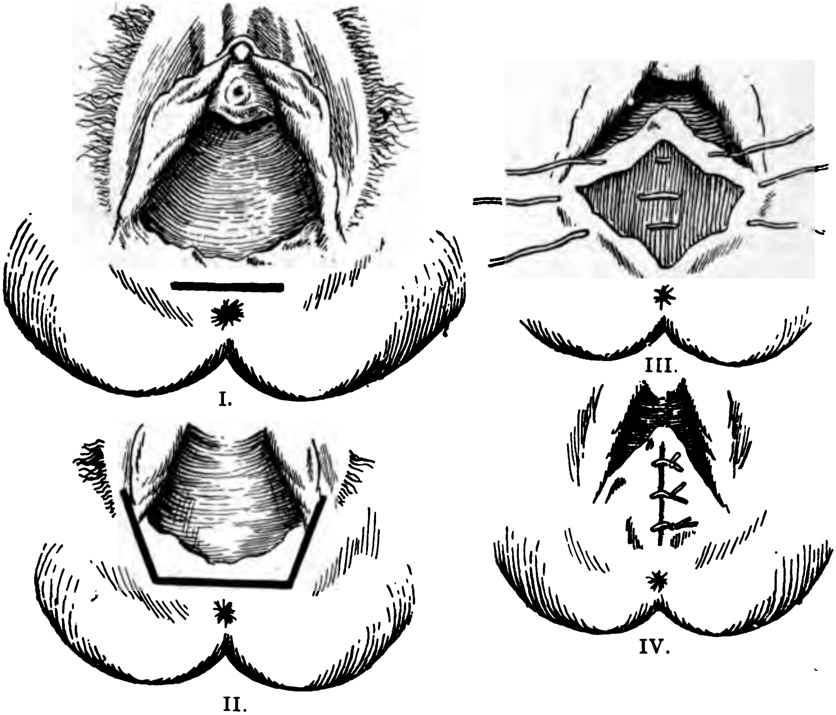

FIG. 208.—OPERATION FOR PARTIAL RUPTURE OF THE PERINEUM.

I. This shows position of the transverse incision. II. This represents the two lateral incisions completed. III. This shows the wound opened antero-posteriorly and the suture inserted. IV. Represents the sutures tied up.

tion is to convert the wound into a diamond-shaped space; this is brought about by pulling up the upper portion of the transverse cut. With this upper portion held up, deep sutures are passed in the following manner: At about ½ an inch outside the upper limit of the vertical cuts a strong curved needle on a handle is passed deeply into the tissues on one side, made to run through the upper flap without perforating into the vagina, into the tissues well on the other side, and so out on the other side about the upper limit of the vertical cut, and ½ an inch beyond the raw edge. In like manner about four sutures are passed. The same precautions are taken not to perforate the lower flap, and so wound the rectum. The parts are thoroughly washed; and it will be found, on drawing on these sutures and tying them up, that the lozenge-shaped space has been converted into a vertical median wound.

Operation for Complete Rupture of the Perineum (Fig. 209).

This is carried out very much on the same lines. But when the rupture is complete, vertical descending cuts are also made on each side of the anus, so as to enlarge the diamond-shaped wound and carry it down well into the anus; so that when the wound is brought together with the sutures the anus will be tightened up or filled in, and the torn surfaces of the sphincter muscles are brought close together. In other respects the operation is carried out and completed as for a partial perineal rupture. More sutures are, however, required, as the vertical median wound is longer.

Memoranda.

I. Never cut away any tissue, so that, should the operation fail, there is no loss of tissue, and a second operation can be performed.

II. When making the transverse incision, be careful not to wound the vagina or rectum. Cut into the cellular interval between them, for then the two tubes separate easily and readily.

III. Separate the parts freely by opening the cellular tissue, not only in the transverse cut, but also in the side ones.

IV. In passing the deep sutures carry them deeply into the tissues on each side, so as to obtain a firm hold to bring the deeper parts of the diamond-shaped cavity into close apposition.

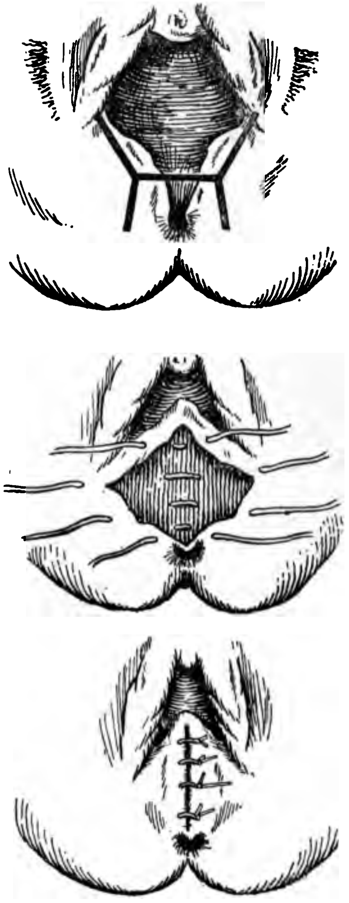

FIG. 209.—OPERATION FOR COMPLETE RUPTURE OF THE PERINEUM.

V. When tying up the sutures, relax the parts by taking off the crutch and bringing the knees together.

CHAPTER VIII

OPERATIONS ON THE RECTUM

Anatomy (Figs. 210 and 211).

The rectum extends from the left sacro-iliac joint to the anus. The upper portion, which is situated between this joint and about the middle of the sacrum, is completely covered by peritoneum.

The second portion, which extends from the middle of the sacrum to the tip of the coccyx, is covered by peritoneum only on its anterior surface about its upper part—that is to say, where the peritoneum is reflected off it on to the bladder at the base of the trigone. The lowest part extends from the apex of the coccyx to the anus, and is surrounded by the external sphincter, and about ½ inch above this by the internal sphincter. Just about the level of the internal sphincter the levator ani is inserted into it.

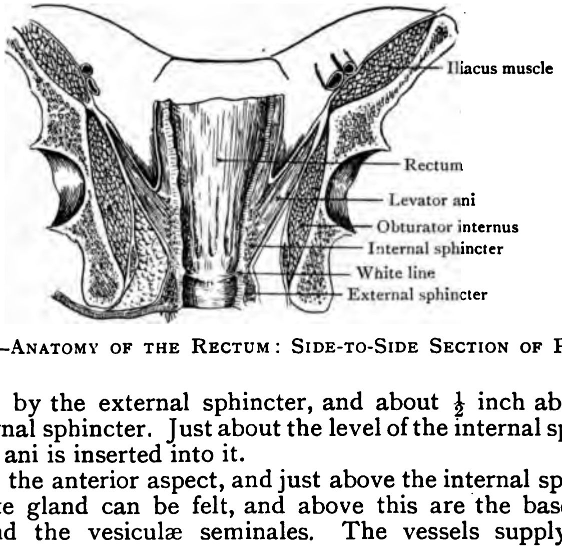

Fig 210.—Anatomy of the Rectum: Side-to-Side Section of Pelvis.

Towards the anterior aspect, and just above the internal sphincter, the prostate gland can be felt, and above this are the base of the bladder and the vesiculæ seminales. The vessels supplying the rectum are the superior hæmorrhoidal, from the inferior mesenteric artery; the middle hæmorrhoidal, from the internal iliac; and the external or inferior hæmorrhoidals, from the internal pudic.

The superior and middle hæmorrhoidal vessels pass downwards in the long axis of the rectum lying just beneath the mucous membrane, and are the vessels concerned in internal piles. The inferior hæmorrhoidal vessels pass to the rectum at right angles to its long axis, and pass to the mucous membrane just between the two sphincters, breaking up into branches to supply the skin and mucous membrane of the anus.

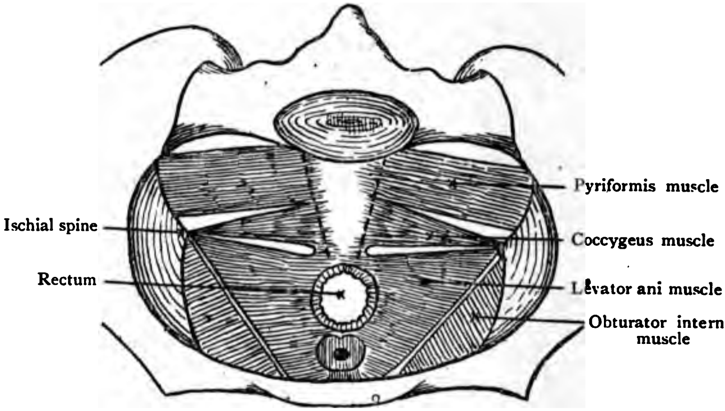

FIG. 211.—DIAGRAM TO SHOW STRUCTURES FORMING THE PELVIC FLOOR.

Veins of the Rectum.—The hæmorrhoidal plexus of veins surrounds the lower end of the rectum. From it pass three main sets of veins: the superior hæmorrhoidal veins, which empty into the inferior mesenteric vein, and so into the portal vein; the middle and inferior hæmorrhoidal veins, which empty into the internal iliac vein—that is, into the systemic veins. The hæmorrhoidal plexus receives blood from the vesical plexus and prostatic plexus in the male, in the female from the vesical and uterine plexuses.

Lymphatics of the Rectum.—These are large in size, and pass first to some small glands that lie upon the outer wall of the rectum and in the meso-rectum, and thence to the lumbar and sacral glands. The lymphatics of the anal margin drain into the inguinal glands.

OPERATIONS FOR PILES.

There are many operations, but only four will be described:

Ligature with incision.
Crushing.
Clamp and cautery.
Whitehead's operation.

Ligature with Incision (Fig. 212).—The patient is placed on the right side, with the legs drawn up towards the abdomen and the buttocks well to the edge of the couch. The surgeon kneels or sits facing the buttocks; the assistant, standing at the back of the patient and facing the operator, with the right hand holds up the left buttock. The anus is thoroughly dilated with the fingers so as to allow of protrusion of the piles. Then with ring or clip forceps a pile is grasped and pulled down. The pile being held down by the left hand, a cut is made with scissors so as to separate the pile from its connection with the muscular and submucous tissues on which it rests. The cut is about ½ an inch long and parallel to the long axis of the bowel. This cut is sufficiently deep to free the pile from the gut, except at its upper part, or base, so that it is left connected by an isthmus of vessels and mucous membrane only.

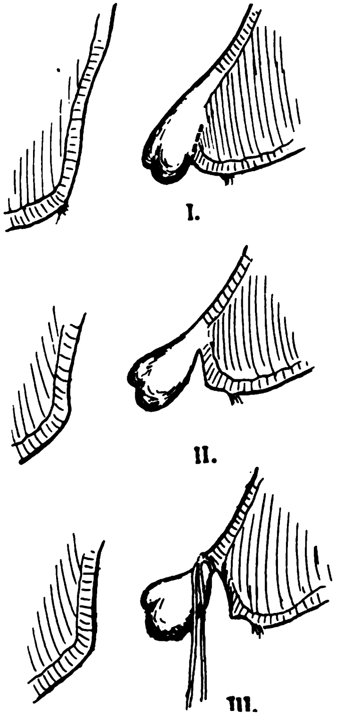

FIG. 212.—DIAGRAM TO SHOW THE METHOD OF REMOVING A PILE BY LIGATURE.

I. The dotted line represents position of the incision. II. The pile freed except at the base. III. The ligature in position.

There is no danger of injuring the large vessels supplying the pile, as these enter it from above immediately beneath the mucous membrane.

The assistant then takes charge of the clip that holds the pile, and the operator applies the centre of a ligature into the cut made for freeing the pile. While the assistant holds down the pile, the surgeon ties the ligature around the pile at its base. The ligature is tied as tightly as possible, and three knots are made, so as to insure that there is no slipping. Each pile is so dealt with. The piles when ligatured are returned within the anus, any flaps of skin that are left outside being snipped off.

Memoranda.

I. Always employ forcible dilatation of the sphincter with the fingers, for this allows the piles to protrude.

II. Be most careful to ligature the pile right up at the highest point of the division, so as to secure all the vessels.

III. Tie the ligature as tightly as possible, so that there is no likelihood of its slipping.

Crushing.—The patient being in the same position and the sphincter dilated freely, each pile separately is caught hold of and drawn into the screw-crusher. This is firmly screwed up, and the pile beyond the crushed part is cut away. The crusher is left on for at least two minutes, and then slackened and the crushed stump allowed to slip back. Each pile is dealt with in this fashion.

Memoranda.

I. In removing the crusher, slacken it off gradually, thus allowing the stump to slip away slowly from the crusher, which must not be dragged roughly away.

II. While dealing with each pile, be careful not to disturb too much the already crushed stumps.

Clamp and Cautery.—The position of the patient is the same as for the preceding operations. The pile is drawn down and the clamp applied to it, the parts on the distal side of the clamp are burnt away with the cautery at a dull red heat. The clamp is then relaxed and the stump allowed to slip back. Each pile is in like manner dealt with.

Memoranda.

I. Be careful to burn thoroughly each portion of pile on the distal side of the clamp.

II. The cautery must not be too hot.

Whitehead's Operation.—The sphincters being dilated thoroughly, the mucous membrane of the lower part of the rectum is separated from the skin at the muco-cutaneous junction with blunt-pointed scissors. This mucous membrane is then dissected up for about 1½ inches all round and drawn down; that is to say, the whole of the pile-bearing area of the rectal mucous membrane is drawn outside the anus. It is then cut away transversely, any bleeding-points being seized with pressure forceps. The free edge of the mucous membrane is then sutured to the anal margin.

Memoranda.

I. The bowel should be cut through by degrees, and all vessels secured as they are cut. As each portion of the circumference of the bowel is dealt with, it should be stitched to the corresponding portion of the anal margin. This procedure is repeated until the entire circumference of the bowel is secured to the skin.

II. The skin at the anal margin must not be cut, as otherwise there will be a tendency to subsequent stricture.

EXCISION OF THE RECTUM.

Operations.

From the perineum (Allingham).
Through the sacrum (Kraske).

Operation from the Perineum (Fig. 213).—The patient is placed in the lithotomy position, the legs being separated with Clover's crutch and the buttocks brought well to the end of the table. The operator sits facing the buttocks, and an assistant stands on each side of the patient, holding the legs. In the male a large silver catheter should be passed into the bladder, to act as a guide to the urethra while the rectum is freed at its anterior parts. The operator inserts his left forefinger into the bowel, the palmar surface being turned downwards. A long, thin, sharp-pointed knife is pushed through the skin about ½ an inch behind the anus in the middle line behind, penetrating deeply into the tissues, but keeping outside the rectal tube. The left forefinger in the rectum serves to prevent the gut being injured. The knife is then made to cut the tissues in the middle line right down to the apex of the coccyx, or, if much room is needed, it may be continued right backwards to the left side of the coccyx. Next a sponge is packed into the incision to stop any bleeding. If the disease does not descend right to the anus, a knife is inserted into the interval between the external and internal sphincters, and made to cut deeply on both sides into the fat of each ischio-rectal fossa. If the growth involves the anus, the lateral incisions are made on each side through the skin into the ischio-rectal fossæ. The ends of these cuts are made to join the posterior incision behind. With the fingers the rectum is then thoroughly separated from the cellular tissue at both sides and behind. Once more, with the first finger of the left hand in the gut, and the thumb outside resting on the perineum, the anterior extremities of the two lateral cuts are made to join by a transverse one dividing the skin and opening up the cellular tissue of the perineum. The first finger of the left hand being still in the bowel, and the thumb being pushed into the transverse incision, the anterior part of the rectum is separated with scissors, or the fingers, from the urethra, prostate, and base of the bladder in the male, or the vagina in the female. The rectal tube being so far separated, the levator ani, if it has not been torn through on each side by the fingers, must be snipped through with scissors, and thus the rectum fairly freed and brought down.

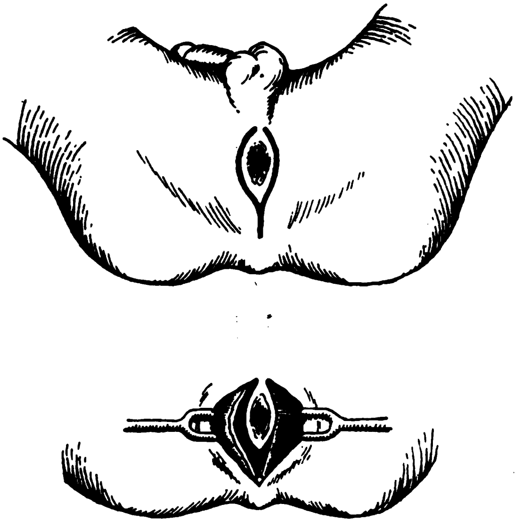

FIG. 213.—EXCISION OF THE RECTUM (AUTHOR'S OPERATION).

In the lower drawing the wound is shown retracted and the levator ani divided on the right side.

From one side the surgeon applies a large pair of Spencer Wells' rectangular pressure forceps on to the highest part of the freed bowel well above the growth, and on the other side a second pair. In this way the circumference of the bowel is well secured, except at a point where the points of the forceps meet and where the fingers can pass into the bowel above, and whence flatus can afterwards escape. Then the lower part of the rectum and the growth are cut away on the distal side of these forceps. The stump of the rectum enclosed in these clips is then secured by a strong ligature passed behind each clip separately, and tied up as tightly as possible. Each clamp is relaxed slowly as the ligature is tightened. By tying each part separately the greater part of the circumference of the bowel is secured, and at the same time a small interval is left through which fæces and flatus can escape. Any bleeding vessels are then tied and the operation completed.

Memoranda.

I. Always make the long posterior cut—it gives good room; but be certain that it is outside the bowel, as then the rectum is left as a tube, and thus its relations and positions much more easily kept in mind while the other parts of the operation are being executed.

II. Cut boldly and deeply into the ischio-rectal fossa, and divide the fibres of the levator ani freely, for it is this muscle that prevents the rectum from coming down.

III. While separating the anterior part of the rectum, always keep the finger of the left hand in the bowel and the thumb outside in the cellular tissue of the perineum. By this device one can tell the position of the bowel, and the scissors can then be kept close to it; there is thus less fear of wounding the vagina in the female, or the prostate or bladder in the male.

Operation through the Sacrum (Kraske) (Fig. 214).—The patient is placed on the right side, and a long incision is made from just about the anal margin straight up the back to about the upper part of the sacrum, in the middle line. The soft parts down to the sacrum and coccyx are thoroughly cleared and retracted; the coccyx is then dissected out, and if more room is required the lower part of the sacrum may be cut away with bone forceps. Often it is only necessary to remove the coccyx, this giving sufficient room if the growth is low down.

Then with the fingers and the handle of the knife the bowel is separated all round, and drawn as much as possible out of the wound. It is next cut through above the growth. If the peritoneum on the front of the rectum has been opened, it should be protected with sponges. The upper part of the divided gut is then commanded, and, all the bleeding vessels being secured, it is left while the lower part of the gut and growth are carefully dissected away from their connections in front. After the growth has been removed, one of the following procedures can be adopted: If possible, the upper end of the divided gut is united by some form of bobbin (Murphy's or Allingham's) to the upper end of the lower part of the gut.

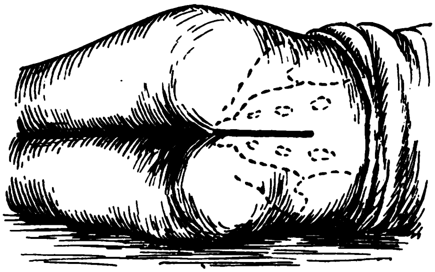

FIG. 214.—INCISION FOR KRASKE'S OPERATION.

Bones outlined with dotted line.

Or by freeing the mesentery of the upper part of the rectum the gut can be drawn down and stitched to the skin at the anal margin, the lower part of the rectum with the growth having been carefully dissected away, leaving the internal and external sphincters uninjured.

If either of the above procedures are impossible, the upper divided end of the gut is brought into the upper end of the posterior sacral wound and fixed there. The skin wound is sewn up entirely in the first two states, but in the third the divided gut is carefully secured with many sutures to the skin-wound.

Memoranda.

I. Make a long enough skin cut, so as to have sufficient room to work in.

II. If the peritoneal cavity is opened, carefully protect it, and afterwards sew it up with buried sutures.

III. While separating the rectal mesentery, to allow the upper part of the rectum to come down, divide the mesentery as far away from the gut as possible, so as to avoid injury to the vessels which supply the gut.

PART VII

CHAPTER I

OPERATIONS UPON THE VERTEBRAL COLUMN

Anatomy.

THE spinal cord extends from the foramen magnum to the body of the first lumbar vertebra. The largest portion of the cervical enlargement of the cord is opposite the fifth and sixth cervical vertebræ. The greater part of the lumbar enlargement is opposite the twelfth dorsal vertebra.

The dura mater with the cerebro-spinal fluid of the cord extends to the second piece of the sacrum.

The origin of the eight cervical nerves corresponds to the interval between the occiput and the sixth cervical spine. The origin of the first six dorsal nerves corresponds to the interval between the sixth cervical and fourth dorsal spines. The origin of the six lower dorsal nerves corresponds to the interval between the fourth and eleventh dorsal spines. The origin of the five lumbar nerves corresponds to the interval between the eleventh and twelfth dorsal spines. The origin of the five sacral nerves corresponds to the spines of the last dorsal and first lumbar vertebræ.

Operations.

Excision of spina bifida.
Laminectomy.

Excision of Spina Bifida.—The patient lying over in a semi-prone position, a vertical incision is made through the skin, exposing the dura mater, which lines the sac of the spina bifida. The dura mater is then carefully opened, and any nerves involved in it or adherent to it are separated and placed in the spinal canal; some of the loose dura mater is cut away, and the edges of the cut dura mater united with interrupted sutures over the nerves, the edges being inverted while being sewn, so as to bring together serous surface to serous surface. Lastly, any excess of skin is removed and the skin wound united.

Memoranda.

I. Cases for the operation must be carefully selected, since operation is by no means applicable to all.

II. Carefully separate any nerves that are adherent to the dura mater, and replace them in the spinal canal.

III. If possible, cut away the skin more freely on one side of the spina bifida, so that when the skin wound is united it may be to one side of the middle line, and not directly over the suturing of the dura mater.

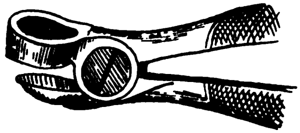

FIG. 215.—HORSLEY'S BONE FORCEPS.

Laminectomy (Fig. 215).—The patient being placed as far as possible in a prone position, a long incision is made vertically over the spinous processes of the vertebræ which are to be dealt with. The deep fascia is divided longitudinally. The muscles are then with a raspatory well freed from each side of the spinous processes and firmly retracted. The spinous processes being then freed, the laminæ are thoroughly exposed, and cut through as near as possible to the transverse processes with Horsley's bone forceps or a saw. The divided laminæ and spinous processes are then removed with bone forceps. The fat covering the dura mater of the cord is exposed, and is divided in the middle line behind. It is retracted and the dura mater exposed. If this requires opening, it is seized with toothed forceps, and as much of it as is necessary is opened with a knife. The spinal cord is next seen, and can be dealt with as the case may indicate—namely, blood-clot removed or growth excised, etc. The dura mater may then be sewn up, except a small point at the lower angle of the cut, which, if necessary, is left open for drainage. The fat and muscles, after all bleeding has been checked, are replaced, a drainage-tube being inserted into the deepest parts of the wound, and lastly the skin wound united.

Memoranda.

I. Make the incision long enough, so as to give room, and freely divide the deep fascia transversely, as well as from above downwards, so as to allow of easy retraction of the deeper parts.

II. Open the fat which covers the dura mater in the middle line behind, to avoid the many veins in its substance which would be wounded and might bleed freely if the incision were made to one or the other side.

III. When the dura mater is opened, keep the patient lying flat, and do not raise the head. If these precautions are taken, the flow of cerebro-spinal fluid soon ceases.

IV. If the operation has been done for abscess or injury, cut away all dense fibrous tissue or bone, dead or healthy, that may be pressing on the cord.

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